Onondaga County CSO Program Evaluation Report

Lake Improvement Project Office

Onondaga County
Department of Drainage and Sanitation

May 2001

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Acknowledgements

The CSO evaluation report was prepared as a collaborative effort by the following engineering firms that are providing services on the CSO Program as part of the Lake Improvement Project including:

Barton & Loguidice, PC
CDM/C&S Joint Venture
Environmental Engineering Associates, LLP

- Moffa & Associates

The Onondaga County Lake Improvement Project Office and technical staff in the Department of Drainage and Sanitation also played a critical role in the evaluation effort in regards to supplying specific data and general knowledge of the system and review of the document.

1.0 Introduction

1.1 Purpose

Onondaga County is under an Amended Consent Judgment (ACJ) which was signed by the Federal Court on January 20, 1998. The scope of the ACJ involves upgrades to the Metropolitan Syracuse Wastewater Treatment Plant (Metro) and improvements to the combined sewer system tributary to Metro to abate the numerous combined sewer overflows (CSOs) that exist. Appendix B of the ACJ lists a series of interim and major CSO projects that the County must implement over a period of years specifically established in this Appendix. A copy of Appendix B of the ACJ is provided in Appendix K of this report. In turn, the CSO projects listed in the ACJ were developed in a 1991 CSO Facilities Plan and later modified in the 1996 Draft Municipal Compliance Plan and Draft Environmental Impact Statement submitted to the Department of Environmental Conservation by Onondaga County.

The purpose of the CSO Evaluation Report is:

- To review the entire existing CSO system.
- To document refinements in the CSO program resulting from completion of several CSO abatement projects.
- To review the basis of the projects individually and collectively in achieving federal and state water quality objectives.
- To verify and confirm that the program will achieve federal and state water quality standards and policies in compliance with the 1972 Clean Water Act as amended.
- To address general and project specific issues regarding the appropriateness and effectiveness of the CSO abatement program in the context of the ACJ and community interests.

The rationale for conducting the evaluation is based on the need to incorporate information and data determined during detailed planning and design of specific projects during 1998 and 1999 and to reconfirm the viability of the overall program in light of new information and refinements to the CSO program that have occurred. Since the evaluation process needed to be comprehensive, it was decided not to try to accomplish it as part of any one project, but to incorporate contemporaneous planning and design efforts into a separate process.

The essential objectives of the CSO evaluation were:

- To determine the impact of the improved combined sewer system on the capacity and operations of Metro.
- To verify and confirm the efficacy of the "tools" utilized to model the system.
- To evaluate alternative technologies and approaches to achieving water quality standards.
- To determine whether a combination of supplemental or alternate projects would be more cost effective or provide enhanced water quality.

ACJ related improvements to the combined sewer system were divided during the negotiated settlement into two groups:

- Interim projects (to be completed by July 1, 2002, with the exception of sewer separation)
- Major projects (completion dates established by project)

These two groups of projects combine to make up the County's Long-term CSO Control Plan.

1.2 Background

Onondaga County has been making modifications and improvements to its combined sewer system since the 1970s and early 1980s, when the initial Combined Sewer Overflow (CSO) Facility Planning work was conducted. Two CSO demonstration projects were constructed and evaluated at that time, along with ongoing water quality assessments. Best Management Practices (BMPs), to improve the operation and efficiency of the combined sewer system, were recommended and implemented in the early 1980's, which were very successful in reducing the frequency and magnitude of the CSO discharges. Facility planning activities were continued after the Atlantic States Legal Foundation filed suit against the County regarding water quality violations resulting in New York State Department of Environmental Conservation (NYSDEC) Consent Order in 1989. The Consent Order required the County to proceed with development of a municipal compliance plan (MCP) for upgrading treatment processes at Metro and to abate combined sewer overflows (CSOs)

A Draft MCP and Environmental Impact Statement (DEIS) were submitted to the NYSDEC and Atlantic States Legal Foundation in January 1996. The MCP was found to be unacceptable by Atlantic States Legal Foundation and negotiations ensued ultimately resulting in the Amended

Consent Judgment (ACJ) agreed to by the parties in 1997 and signed by the Federal Court on January 20, 1998.

For the most part, projects contained in the MCP were embodied in the ACJ and supplemented and augmented with various other requirements. Primary water quality objectives of the ACJ include reductions in the loading of phosphorus and ammonia to Onondaga Lake (through Metro improvements) and the reduction of bacterial and floating solids loading by improvements to the combined sewer system. The CSO projects included in the ACJ were determined during the negotiations leading to the ACJ to achieve compliance with the requirements of the Federal "CSO Control Policy" enacted in April 1994 and the New York State "CSO Control Strategy" dated October 1993. The evaluation report largely addresses the improvements to the combined sewer system, although there are a number of related Metro issues.

A list of interim and major CSO projects from the ACJ are included in Table 1-1 along with notes on their current status. Figure 1-1 shows the location of the specific CSO abatement projects required by the ACJ while Figure 1-2 shows the location and geographical service area coverage of these CSO projects. Figure 1-3 provides the location of other major combined sewer improvement projects recently undertaken by the County outside of the ACJ.

1.3 Process

A number of workshops with representatives of the design engineers and project management team were held to address each of the objectives. Staff members from the Lake Improvement Project Office and Department of Drainage and Sanitation attended and participated in several of the workshops.

The evaluation included both individuals with long experience in working on the Metro plant improvements and the CSO program and individuals with little or no experience with the Metro/CSO system but with strong knowledge of sewer system engineering including CSO abatement and systems modeling. There was a conscious effort to "think out of the box" as the team considered the overall program and subsequent task assignments.

Also, several significant CSO projects were in various stages of facilities planning or final design during the time the evaluation was performed, including:

- Kirkpatrick Street Pump Station Upgrade and Force Main-design
- Midland Regional Treatment Facility and Conveyances-design
- Clinton Street CSO Abatement-facilities planning
- Harbor Brook CSO Abatement-facilities planning

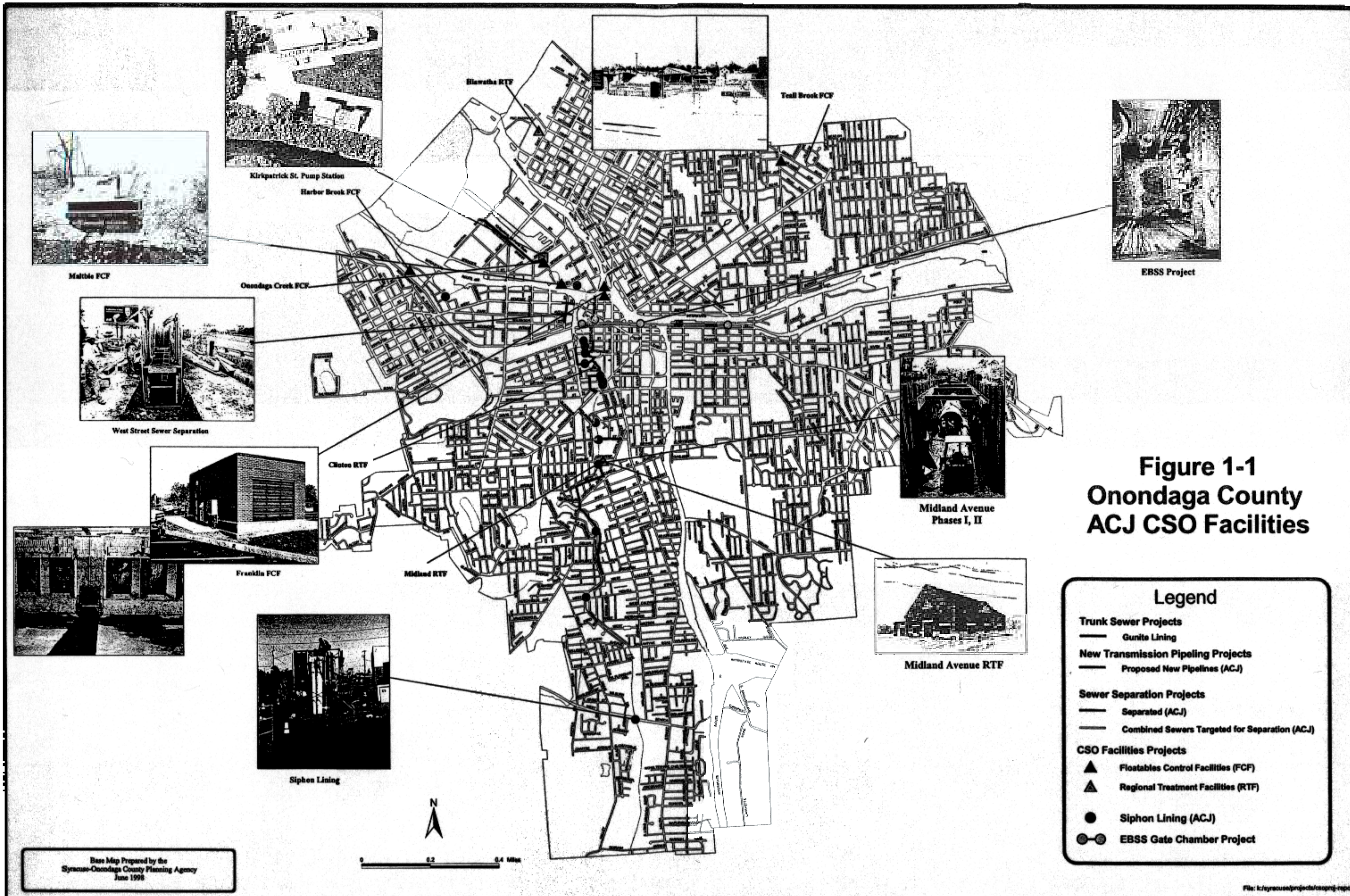


Figure 1-1
Onondaga County
ACJ CSO Facilities

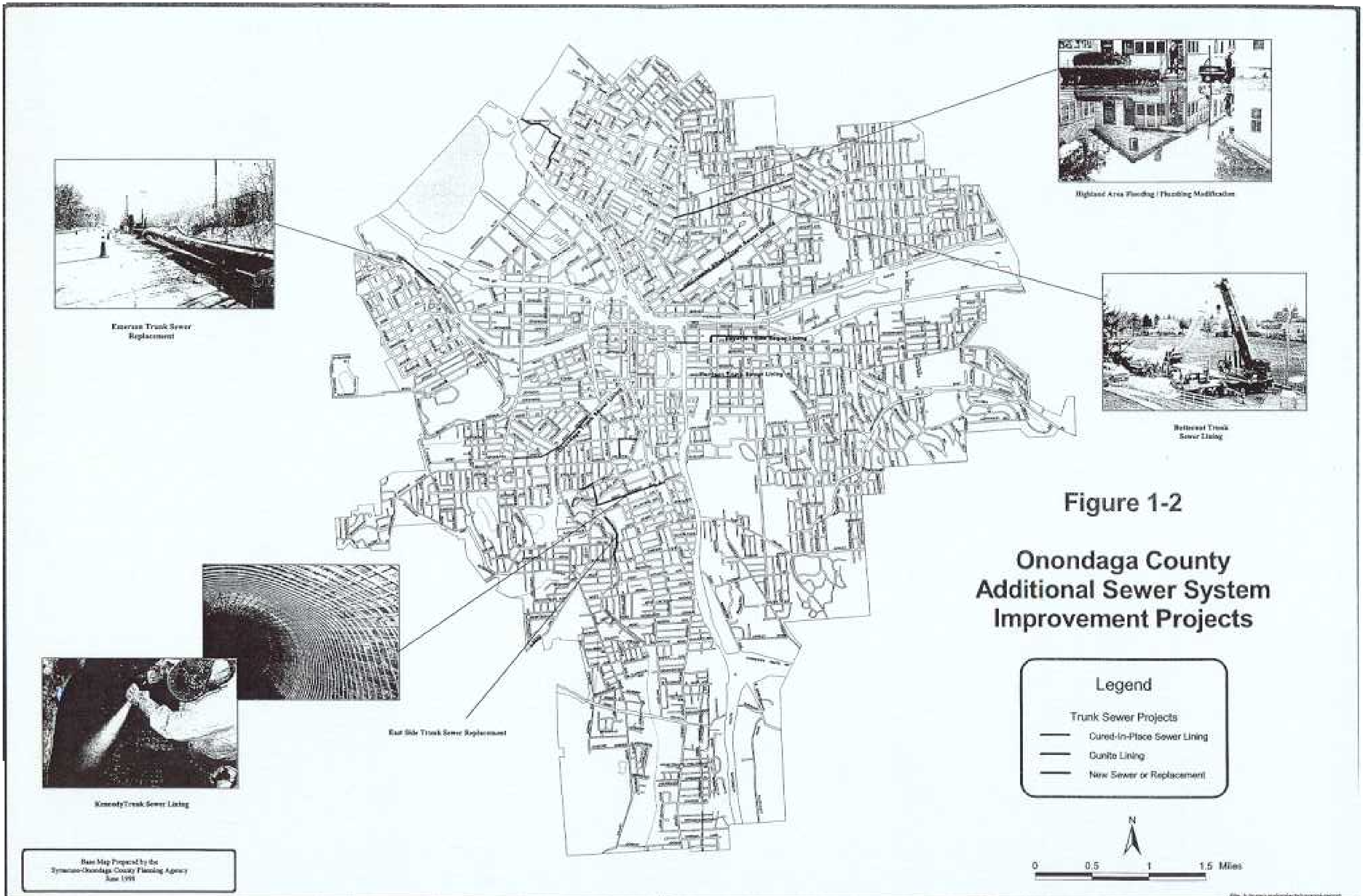


Figure 1-2

Onondaga County Additional Sewer System Improvement Projects

Figure 1-3
Onondaga County CSO Facilities and Related Combined Sewer Service Areas

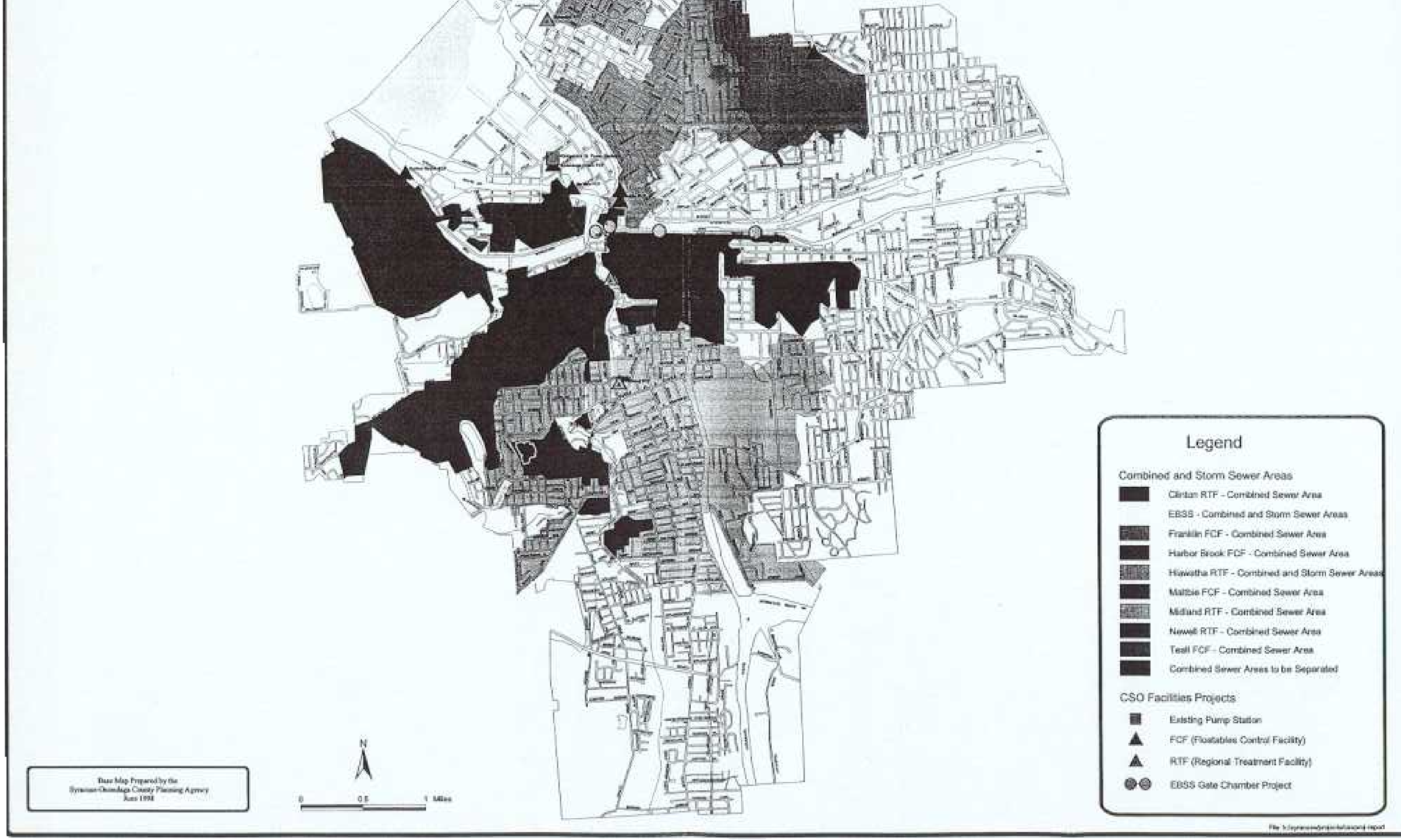


TABLE 1-1

ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT

ONONDAGA COUNTY CSO PROGRAM STATUS AND POTENTIAL MODIFICATIONS

PROJECT NAME	DESCRIPTION OF PROJECT	STATUS
INTERIM PHASE PROJECTS		
Hiawatha Boulvard RTF Demonstration Project	Construction of CSO interceptor pipelines and vortex separator with disinfection and storage	Construction is complete and ready for startup
Newell Street RTF	Reactivation of existing swirl concentrator and disinfection facility. Evaluation of different disinfection processes.	Disinfection evaluation project completed
Harbor Brook In-Water System	Construction in Onondaga Lake of a "flow balance method" of floating pontoons and weighted curtains to entrap wet-weather flow from Harbor	Significant impediments to implementation will likely eliminate project, ongoing facility planning effort to assess alternatives
EBSS Storage Upgrade	Reactivation of storage system with the construction of new controls and other collection system improvements	Under design
Kirkpatrick Street Pumping Station Upgrade	Upgrade of the pump station capacity with construction of a new force main to Metro for wet weather flows	Bidding/Award Phase
Onondaga Creek	Construction of a floatables boom for Onondaga Creek	Under Design
Harbor Brook FCF	Construction of a net bag facility for Harbor Brook	Under Design
Teall Brook FCF	Installation of a "combing" type mechanical	Bidding/Award Phase
Environmental Benefit Project (EBP)	Confirmation of the impact of non-point nutrient loading to Onondaga Lake	EBP project underway
Evaluation of Siphon Crossings	Evaluation and repair of siphon structures along Onondaga Creek and Harbor Brook	Construction Completed
Evaluation of CSO Toxicity	Monitoring of the collection system adjacent to industrial discharge and evaluation of control methodologies to minimize or eliminate potential toxics from CSO discharges	Scoping Phase
MAJOR PROJECTS		
Midland Conveyances and RTF	Construction of CSO transmission facilities and a regional treatment facility with disinfection	RTF Facility under design, Phase I transmission facilities have been completed
Clinton Conveyances and RTF	Construction of CSO transmission facilities and a regional treatment facility with disinfection	In preliminary design phase
Franklin FCF	Construction of net bag type of facilities near the terminus of the Butternut and Burnet Avenue Trunk Sewers	Construction completed, facilities are operational
Maltbie FCF	Construction of a net bag facility at Onondaga Creek and Maltbie Street	Construction completed, facilities are operational
Sewer Separation	Construction of separate sanitary and/or storm sewers	Design near completion - Onondaga Creek Basin. Harbor Brook Basin in planning stages

Information and data developed and issues raised in each of these projects were incorporated into the scope of the evaluation where they addressed or affected the purposes and objectives of the evaluation. After the second workshop, individuals formed groups and were tasked to review data, information, systems, problems, opportunities and/or issues identified in the workshops.

Task Areas	Lead Responsibility
Relationship between CSO program and Metro capacity and operations-Kirkpatrick Street Pump Station and overall CSO Program	EEA and Moffa & Associates
QA/QC review of the SWMM hydraulic model used to predict flows in the combined sewer system and Bacteria model used to determine compliance with bacteria concentrations in Onondaga Lake as related to proposed improvements in the combined sewer system	CDM/C&S Joint Venture and Moffa & Associates
Identify and screen alternative CSO technologies and approaches for application in the Metro CSO program	EEA, Moffa & Associates and CDM/C&S Joint Venture
Analyze specific program options developed during the screening process and make recommendations as whether the County should undertake more definitive planning and design of any of these options	CDM/C&S Joint Venture

2.0 Existing CSO System and CSO Abatement Program

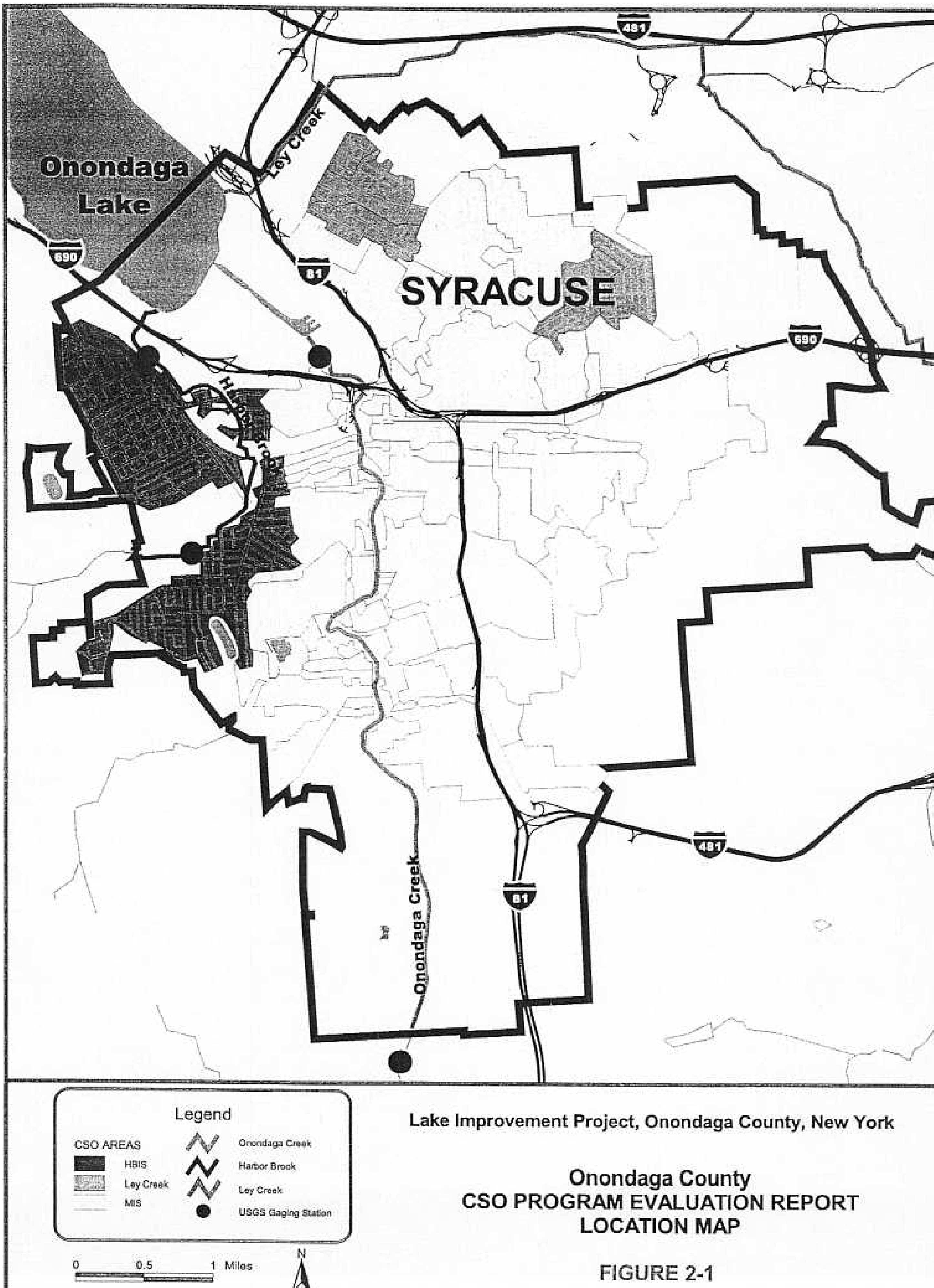
2.1 Description of Combined Sewer System

The combined sewer system tributary to the Metropolitan Syracuse Treatment Plant (Metro) encompasses an area of 6,812 acres, or approximately 10 square miles. As shown on Figure 2-1, the combined sewer area is located totally within the Corporate Limits of the City of Syracuse. There are two major combined sewer drainage basins tributary to Metro: the Harbor Brook Service Area (via the Harbor Brook Interceptor Sewer) and the Onondaga Creek Service Area (via the Main Interceptor Sewer). A principal contributor of wet-weather flow to the Main Interceptor Sewer (MIS) is the Erie Boulevard Storm Sewer, which was previously modified to act as a CSO storage facility. The Erie Boulevard Storage System (EBSS) Upgrade project will undertake a renovation and upgrade of the existing facilities to allow reactivation of this system. The MIS service area contains a portion of the Ley Creek natural drainage basin. Two different CSO areas the upper Butternut/Grant Trunk Sewer service area (CSO 073) and the upper Hiawatha Trunk Sewer service area (CSO 074), discharge their excess stormwater into Ley Creek. All dry-weather flow from the CSO 073 area is discharged to the MIS system via the Butternut trunk sewer while the dry-weather flow from the Hiawatha trunk sewer is tributary to the MIS via the Kirkpatrick Street Pump Station.

Prior to the construction of the interceptor sewers during the first part of the last century, combined sewers discharged directly to Harbor Brook, Onondaga Creek, and Ley Creek. Records indicate that the trunk sewers were designed to transmit 0.5 cfs per acre of tributary area. With growing concern over the health effects and odors associated with this practice, interceptor sewers were constructed to transmit the dry-weather flow (and a fraction of stormwater runoff equal to a rainfall intensity of 0.02 to 0.04 inches per hour) to Onondaga Lake. Despite the relatively low rainfall allowance in the design of the interceptors, the design parameters resulted in construction of large-diameter pipes. The Harbor Brook Interceptor is a 54-inch diameter pipe along Hiawatha Boulevard, and the Main Interceptor Sewer is 90-inches in diameter at its largest.

A diagram of a typical connection of a combined sewer to an interceptor sewer is shown on Figure 2-2. The diversion manholes (also known as the overflow manholes) were typically constructed at the same time as the interceptor sewers and interceptor manholes. The sewer, which connects the combined sewer and the interceptor sewer, is known as the regulator sewer because it was intended to regulate or control the amount of combined sewage being discharged to the interceptor sewer. Many of these regulator devices were subsequently modified to accept more combined sewage because the objective of the BMP program was to maximize flow to Metro for treatment.

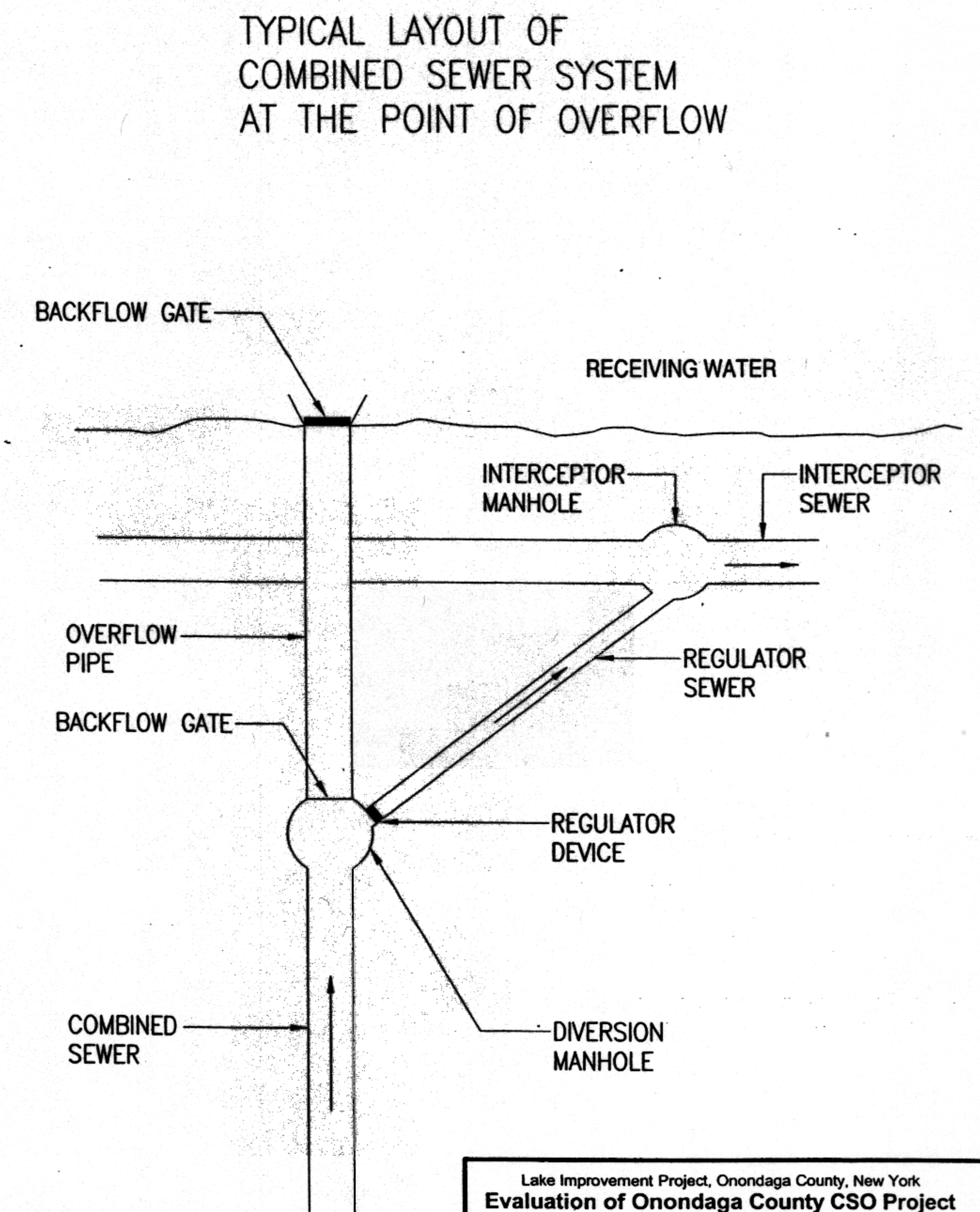
As shown on Figures 1-1 and 2-1, the combined sewer system for the City of Syracuse has been constructed within the Onondaga Creek, Harbor Brook, and Ley Creek watersheds of Onondaga Lake. During periods of heavy rainfall, combined sewer overflows are directed to these watercourses. In portions of the Onondaga Creek and Ley Creek basins, storm sewers are tributary to the combined sewers or overflow points and must be considered in the development



Lake Improvement Project, Onondaga County, New York

Onondaga County
CSO PROGRAM EVALUATION REPORT
LOCATION MAP

FIGURE 2-1



Moffa & Associates
A Unit of Brown and Caldwell

Lake Improvement Project, Onondaga County, New York
Evaluation of Onondaga County CSO Project
Summary Report
Typical Layout of Combined Sewer System
Figure 2-2

of the different CSO abatement alternatives. Individual CSO acreages are in Table 2-1 and major basin acreages with overflow numbers summarized below.

Basin	*Number of Basin Overflows*	*Combined Acreage*	*Percentage of Total Combined*	*Storm Sewer Acreage*	*Total Acreage*
Harbor Brook	18	1,287	18.9%	0.0	1,287
Onondaga Creek	43	5,264	77.3%	637	5,901
Ley Creek	2	261	3.8%	628	889
TOTALS:	63	6812	100%	1265	8,077

*Note: The West Street Sewer Separation Project completed in December 1999 eliminated 3 overflows leaving 40 CSOs to Onondaga Creek at this date including the Spencer Street Bypass.

2.2 Regulatory and ACJ Requirements

The national CSO policy requires that municipalities meet either the "presumption" or "demonstration" approach in developing a CSO control program. However, if a community chooses the "presumption" approach, it does not preclude having to meet the demonstration approach later. An excerpt from the Federal Register is included in Appendix A, which defines both approaches.

The ACJ requires that the County meet the "presumption" approach and for bacteria, the demonstration approach for "Class B" waters of the lake. Other municipalities, in addition to Onondaga County, are finding that a combination of both approaches is appropriate for their particular situations. Table 2-2 lists the approaches being followed by several municipalities in the Eastern United States.

In accordance with the ACJ;

"14. The County shall design, construct, maintain, and modify and/or supplement, as necessary, a CSO control and upgrade program in accordance with DEC CSO guidance, as set forth in TOGS 1.6.3 (CSO Control Strategy), which implements the "presumptive approach" in EPA's CSO control policy, as set forth in 59 F.R. 18688 (April 18, 1994). The County's program shall achieve the following:

A. elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis [this requirement is consistent with the national CSO policy for the presumption approach],

B. elimination or minimization of floating substances in Onondaga Lake attributed to the County's CSOs, and

TABLE 2-1
ONONDAGA COUNTY CSO EVALUATION REPORT
ONONDAGA COUNTY CSO ACREAGE AND ABATEMENT APPROACH

CSO NUMBER	RECEIVING WATER	ACREAGE	CSO ABATEMENT APPROACH
003	Harbor Brook	112	Ongoing Facility Plan
004	Harbor Brook	350	Ongoing Facility Plan
005	Harbor Brook	17	Ongoing Facility Plan
006a	Harbor Brook	7.8	Ongoing Facility Plan
007	Harbor Brook	29.4	Ongoing Facility Plan
008	Harbor Brook	7.5	Ongoing Facility Plan
009	Harbor Brook	31.5	Ongoing Facility Plan
010	Harbor Brook	18.4	Ongoing Facility Plan
011	Harbor Brook	28.7	Ongoing Facility Plan
013	Harbor Brook	4.4	Ongoing Facility Plan
014	Harbor Brook	192	Ongoing Facility Plan
015	Harbor Brook	45.5	Ongoing Facility Plan
016	Harbor Brook	8.5	Ongoing Facility Plan
017	Harbor Brook	25.3	Ongoing Facility Plan
018	Harbor Brook	145	Ongoing Facility Plan
063	Harbor Brook	137	Ongoing Facility Plan
078	Harbor Brook	112.9	Ongoing Facility Plan
079	Harbor Brook	13.8 Includes 006B	Ongoing Facility Plan
020	Onondaga Creek	618	Existing Franklin FCF for Butternut Trunk Sewer- would be affected by Schiller Park alt.
021	Onondaga Creek	57.5	Existing Franklin FCF for Burnet Trunk Sewer
022	Onondaga Creek	15.3	Sewer Separation (95% Designed)
024	Onondaga Creek	2.9	Sewer Separation (95% Designed)
027	Onondaga Creek	134	Direct to Clinton Regional Treatment Facility
028	Onondaga Creek	23.9	Direct to Clinton Regional Treatment Facility
029	Onondaga Creek	7.5	Direct to Clinton Regional Treatment Facility
030	Onondaga Creek	312.1	Direct to Clinton Regional Treatment Facility
031	Onondaga Creek	24.7	Direct to Clinton Regional Treatment Facility
032	Onondaga Creek	24.5	Direct to Clinton Regional Treatment Facility
033	Onondaga Creek	17.7	Direct to Clinton Regional Treatment Facility
034	Onondaga Creek	214	Direct to Clinton Regional Treatment Facility
035	Onondaga Creek	23	Direct to Clinton Regional Treatment Facility
036	Onondaga Creek	188	Direct to Clinton Regional Treatment Facility
037	Onondaga Creek	33.2	Sewer Separation (95% Designed)
038	Onondaga Creek	10.1	Sewer Separation (95% Designed)
039	Onondaga Creek	478	Direct to Midland Regional Facility-CSO Transmission Pipeline constructed
040	Onondaga Creek	12.2	Sewer Separation (95% Designed)
041	Onondaga Creek	2.8	Sewer Separation
042	Onondaga Creek	248	Direct to Midland Regional Facility
043	Onondaga Creek	493.2	Direct to Midland Regional Facility
044	Onondaga Creek	114.5	Direct to Midland Regional Facility
045	Onondaga Creek	6.6	Sewer Separation (95% Designed)

TABLE 2-1
ONONDAGA COUNTY CSO EVALUATION REPORT
ONONDAGA COUNTY CSO ACREAGE AND ABATEMENT APPROACH

CSO NUMBER	RECEIVING WATER	ACREAGE	CSO ABATEMENT APPROACH
046	Onondaga Creek	14.9 (046A)	Sewer Separation (95% Designed)
046	Onondaga Creek	16.4 (046B)	Sewer Separation (95% Designed)
047	Onondaga Creek	0.2	Sewer Separation
048	Onondaga Creek	9.1	Sewer Separation (95% Designed)
050	Onondaga Creek	30	Sewer Separation (95% Designed)
051	Onondaga Creek	25	Sewer Separation (95% Designed)
052	Onondaga Creek	228	Direct to Midland Regional Treatment Facility/Permanent Closure
053	Onondaga Creek	9.6	Sewer Separation (95% Designed)
054	Onondaga Creek	9.9	Sewer Separation (95% Designed)
057	Onondaga Creek	3.9	West Street Sewer Separation-Completed
058	Onondaga Creek	3.0	West Street Sewer Separation-Completed
059	Onondaga Creek	10.7	West Street Sewer Separation-Completed
060	Onondaga Creek	472.6 Includes 077	Direct to Midland Regional Treatment Facility/Permanent Closure
061	Onondaga Creek	2.9	Direct to Midland Regional Treatment Facility/Permanent Closure
065	Onondaga Creek	4.9	Permanent Closure-Pending Final Determination
066	Onondaga Creek	114	Existing Maltbie Floatables Control Facility
067	Onondaga Creek	42.5	Direct to Midland Regional Treatment Facility-Pending Final Determination
071	Onondaga Creek	N/A	Spencer Street bypass-weir to be raised, no discharge at 1-Year Storm
075	Onondaga Creek	91.8	Weir to be raised, no discharge at 1-Year Storm, will be eliminated with proposed Carousel Mall expansion.
076	Onondaga Creek	86.2	Direct to Midland Regional Treatment Facility/Permanent Closure
080	Onondaga Creek	356.8 (080A)	Erie Boulevard Storage System (EBSS)
080	Onondaga Creek	127.8 (080B)	EBSS
080	Onondaga Creek	43.9 (080C)	EBSS
080	Onondaga Creek	124.2 (080D)	EBSS
080	Onondaga Creek	36.9 (080E)	EBSS
080	Onondaga Creek	36.9 (080F)	EBSS
080	Onondaga Creek	20.4 (080G)	EBSS
080	Onondaga Creek	178.4 (080H)	EBSS
080	Onondaga Creek	76.5 (080I)	EBSS
073	Teall Brook	261.5	Direct to Teall Floatables Control Facility-designed
074	Ley Creek	337.2	Directed to Hiawatha Regional Treatment Facility

TABLE 2–2
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
CSO PROGRAMS LONG-TERM CONTROL APPROACHES

SITE	APPROACH	TECHNOLOGY	NOTES
Auburn, NY		Storage, Overflow Retention Facility (ORF) and swirl concentrators.	
Binghamton/Johnson City, NY	Presumption Approach	Combination of treatment plant expansion, sewer separation and screening of remaining Combined Sewer Overflow (CSO) discharges.	Supplemental improvements being performed to enhance collection system.
Buffalo, NY	Presumption Approach Likely	Combination of real time control for storage, sewer separation, CSO interceptor tunnels and regional treatment facilities.	Facility planning is ongoing, floatable control facilities likely for Scajaquada Creek basin.
Columbus, GA		Swirl Concentrators	National Demonstration Facility
Detroit, MI	Demonstration Approach (i.e., demonstrating that it meets design criteria); Michigan MDEQ overrides EPA Policy	Horizontal screen and disinfection with 10 min. storage.	Using in pipe storage, flow into Detroit River is only a fraction and therefore has a lot of dilution. Program captures the 1-year storm completely or provides 30 min. detention on the 10-year storm.
Indianapolis, IN	Under Negotiation		Built on water quality models (receiving streams suffer from fish kills due to low DO).
Louisville, KY	Combination of demonstration approach for Ohio River and presumption approach for tributary streams.	Combination of off-line storage, sewer separation, Continuous Deflective Separation (CDS) units, netting and misc. sewer system improvements.	

TABLE 2–2
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
CSO PROGRAMS LONG-TERM CONTROL APPROACHES

SITE	APPROACH	TECHNOLOGY	NOTES
Manchester, NH	Phase Approach	Separation then possibly tunnels.	
Massena, NY	Presumption Approach	ORF at sewage treatment plant, additional collection system improvements.	Continuing overflow frequency monitoring.
Narragansett Bay, RI	Demonstration - Hybrid of Rhode Island DEM and EPA CSO Policy	Combination tunnels, sewer separation (no swirls or basins).	Primary treatment defined as 50% TSS and 35% BOD.
Nashua, NH	Demonstration - Affordability Analysis	Sewer separation.	EPA Region 1 rejected the presumption approach because 85% capture didn't meet water quality standards.
Onondaga County, NY	Presumption	Regional treatment facilities including swirl concentrators, high rate disinfection and "Storage and Sewer Separation"	Based on 85% capture for treatment during precipitation events on an annual basis, achieving water quality standards for bacteria in Class B portions of the Lake.
Oswego, NY	Sewer Concentrator	Sewer separation with swirl concentrator	Sewer separation has been largely completed.
Rochester, NY	(Program Predates Federal CSO Policy)	Centralized storage tunnels.	CSO abatement largely completed in 1970's and 1980's.
Rouge River, MI	Demonstration Approach (i.e., demonstrating that it meets design criteria); Michigan MDEQ overrides EPA Policy	Storage basins.	National Demonstration Facility

C. achievement of water quality standards for bacteria for all portions of Onondaga Lake that are classified as "Class B" pursuant to 6 NYCRR Part 895 [demonstration approach].

As part of the MCP and ACJ development, modeling was performed to determine compliance with the 85% rule. A calibrated version of the USEPA SWMM model was used to demonstrate that 85% elimination or capture for treatment could be accomplished.

2.3 Description of CSO Program

The current Onondaga County CSO abatement plan utilizes a combination of flow-management approaches and technologies including:

- Sewer Separation

  Regional treatment utilizing vortex separator technology and high-rate disinfection

- Floatables containment and collection

- Storage and transport to Metro for treatment

Project descriptions and the basis of design for each project in the CSO Program are summarized in Table 2-3.

The ACJ CSO Program was originally developed to achieve 85% elimination or capture of the combined sewage volume collected by the combined sewer system tributary to Metro without consideration of the treatment provided by the proposed regional treatment facilities. While the modeling used to develop the CSO Program takes into consideration the CSO captured by the proposed regional facilities, the capture analysis only considered the volume of flow that is conveyed for treatment at Metro and does not include the CSO treated and discharged by the regional facilities.

As part of this CSO Program Evaluation Report, the 85% Capture Analysis was refined using more recent flow data and the actual design assumptions for a number of the projects that have been recently designed and/or constructed. An analysis was performed to evaluate the volume of combined sewage captured under existing conditions, while additional analyses were performed to evaluate future conditions upon completion of the proposed facilities that make up the ACJ CSO Abatement Program.

Table 2-4 provides the results of the analysis for existing conditions, as well as the status of the major projects considered in the 85% Capture Analysis. This table summarizes the estimated average annual combined sewage conveyed to Metro for treatment (Column 1), the combined sewage overflow volume discharged to the affected watercourses (Column 2) and the total volume of combined sewage generated by the combined sewer service areas tributary to Metro (Column 3). The existing percent capture of 74% was determined by dividing the total volume

TABLE 2-3
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
PROPOSED CSO PROJECTS AND BASIS OF DESIGN

Proposed Project	Description of Proposed Facilities	Peak Design Flow Rate (CFS)	Storage Volume (MG)
Hiawatha RTF	29 ft. Dia. Swirl Concentrator, 0.27 MG off-line storage, and Disinfection	65	.047
Harbor Brook CSO Abatement (Long Term Control Facilities)	Facilities planning underway	To Be Determined	To Be Determined
Harbor Brook FCF	In Stream Net Bag System	200 Pending DEC Approval	N/A
EBSS Reactivation	5 MG Gated Storage Conduits	N/A	6
Teall FCF	Weir-Mounted Combing Screen for CSO Flow Only	144	N/A
Onondaga Creek FCF	Boom	600 Pending DEC Approval	N/A
Midland RTF	4, 42 ft. Dia. Swirl Concentrators and Disinfection	667	7.3
Clinton RTF	Facilities planning underway	To Be Determined	To Be Determined
Newell RTF	Reactivation of 12 ft. and 16 ft. Dia. Swirl Concentrator and Disinfection	23	0.07
Franklin FCF – Butternut FCF Burnet FCF	 Net Bag System (8 Bags) Net Bag System (6 Bags)	 311 267	 N/A N/A
Maltbie FCF	Net Bag System (3 Bags)	82	N/A
Sewer Separation	Separation of various Combined Sewer Service Areas totaling 212.8 Acres	Varies	N/A

TABLE 2-4
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
CSO VOLUME CAPTURE TABLE - EXISTING CONDITIONS

Sewer Service Area/ Proposed Facilities	Average Annual Combined Sewage Volume Conveyed to Metro for Treatment (Million Gallons) [1]	Average Annual Volume of Combined Sewage Discharged (Million Gallons) [2]	Total Annual Combined Sewage Volume Generated by the Metro Combined Sewer Service Area (Million Gallons) [3=1+2]	Percent Capture [4=1/3]	Project Status As of May 2001
Hiawatha RTF	116	24	140	83%	Construction
Harbor Brook In-Water System	638	172	810	79%	Planning
EBSS Upgrade	0	289	289	0%	Design
Teall Ave. FCF	77	7	84	92%	Construction
Midland RTF	728	322	1,050	69%	Planning
Clinton RTF	720	142	862	84%	Planning
Franklin FCF	683	83	766	89%	Operating
Maltbie FCF	69	21	90	77%	Operating
Sewer Separation Areas	95	33	128	74%	Varies by Area
Total	3,126	1,093	4,219	74%	

Notes:
1) During dry weather conditions, there is no flow from the EBSS to the Main Interceptor Sewer.
2) The basis of design for each regional facility is the 1-year, 2-hour duration design storm using 15-minute rainfall intervals, with the exception of the Harbor Brook In-Water System which is based upon 1/2 of the 1-year, 2-hour design storm using 15-minute intervals. EBSS is based upon the 90 percentile storm.
3) The estimated capture volumes provided in this table are based upon a SWMM model for the combined sewer system that was validated and calibrated using data collected during an extensive field monitoring program.
4) As the CSO evaluation report is intended to be a "living document", the capture volumes provided in this table will be updated to reflect the current information available at the time of each facility plan or design update.
5) Percent Capture refers to combined sewage captured for treatment at Metro and elimination of combined sewage overflows for separation areas.

captured and conveyed for treatment at Metro by the total volume of combined sewage generated by the combined sewer service area tributary to Metro.

In reviewing Table 2-4, it is important to note that although Column 1 indicates that the Erie Boulevard Storage System (EBSS) conveys no combined sewage to Metro, no dry weather overflows occur as a result of its inactivity. The EBSS conveys no wastewater during dry weather conditions and only receives combined sewage discharges during rainfall events that are large enough to cause an overflow at any of the regulators that discharge CSO to this facility. Since the sluice gates are currently inoperable, no CSO can be captured and diverted to the Main Interceptor Sewer for conveyance to Metro. After the EBSS upgrade, CSO will be stored by the EBSS and conveyed to Metro following the storm event.

A summary of the estimated CSO volumes captured upon completion of the proposed facilities is provided in Table 2-5. This table includes the additional volume of combined sewage that will be captured by the proposed regional treatment facilities and conveyed to Metro for treatment. It also includes the additional combined sewage flow that will be conveyed to Metro as a result of the upgrades to the Kirkpatrick Street Pump Station. The volume of treated CSO discharged to the watercourse by each of the regional treatment facilities is not included in Table 2-5. The estimated percent capture of 90% indicates that the CSO Abatement Program will satisfy the 85% capture requirements of the ACJ.

In an effort to evaluate the total volume of CSO that will receive treatment and disinfection, an analysis was also performed to include the CSO volumes treated by the regional treatment facilities in addition to the combined sewage volume conveyed to Metro. For the purposes of this evaluation, it was assumed that the regional treatment facilities would consist of vortex technology (USEPA Swirl Concentrators) followed by high-rate disinfection. The swirl concentrators remove settleable solids to facilitate high-rate disinfection. For most storms, no discharge of treated waste to adjacent watercourses will occur as a result of the capture of combined sewage within the facilities. Upon considering the capture rates under these conditions on an annualized basis, percent capture rates for the regional treatment facilities will approach those of primary treatment. Table 2-6 summarizes the results of this analysis and shows that 95% of the combined sewage volume generated by the combined sewer service area tributary to Metro will be captured and receive treatment. Those flows that are captured and conveyed to Metro will receive a minimum of primary treatment and disinfection before discharge to Onondaga Lake. Depending upon plant conditions at the time, flow may also receive secondary or tertiary treatment. The flows treated at the regional treatment facilities will receive preliminary treatment and disinfection prior to discharge to the adjacent watercourses.

The above analyses show that the current CSO Abatement Program will result in greater than 85% elimination or capture for treatment at Metro, thereby exceeding the requirements of the Federal CSO policy and guidelines as well as the requirements of the ACJ. In addition, the bacteria standard for water quality requirements in the Class B waters of the lake will be met or exceeded. Memoranda presenting the details of the bacterial projections are presented in Appendix B. Additional discussion of the bacteria model is provided in Section 2.6.

TABLE 2-5
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
CSO VOLUME CAPTURE TABLE - FUTURE CONDITIONS (Treatment at Metro Only)

Sewer Service Area/ Proposed Facilities	Average Annual Combined Sewage Volume Conveyed to Metro for Treatment (Million Gallons) [1]	Average Annual Additional Combined Sewage Volume Eliminated or Captured for Treatment at Metro (Million Gallons) [2]	Total Annual Combined Sewage Volume Eliminated or Captured for Treatment at Metro (Million Gallons) [3=1+2]	Total Annual Combined Sewage Volume Generated by the Metro Combined Sewer Service Area (Million Gallons) [4]	Percent Capture for Treatment at Metro [5=3/4]
Hiawatha RTF	116	23	139	140	99%
Harbor Brook In-Water System	638	143	781	810	96%
EBSS Upgrade	0	220	220	289	76%
Teall Ave. FCF	77	0	77	84	92%
Midland RTF	728	192	920	1,050	88%
Clinton RTF	720	62	782	862	91%
Franklin FCF	683	0	683	766	89%
Maltbie FCF	69	0	69	90	77%
Sewer Separation Areas	95	33	128	128	100%
Total	3,126	673	3,799	4,219	90%

Notes:
1) The capture volumes for the Hiawatha RTF also reflect the additional flow conveyed to Metro by the Kirkpatrick Street Pump Station Upgrade.
2) The basis of design for each regional facility is the 1-year, 2-hour duration design storm using 15-minute rainfall intervals, with the exception of the Harbor Brook In-Water System which is based upon 1/2 of the 1-year, 2-hour design storm using 15-minute intervals. The EBSS is based upon the 90 percentile storm.
3) During dry weather conditions, there is no flow from the EBSS to the Main Interceptor Sewer. Capture volumes reflect re-activation of the EBSS.
4) The capture volumes for Midland RTF include the Newell Street flows.
5) The capture volumes reflect the separation of 212.8 acres of combined sewer service area, as listed in the ACJ.
6) The estimated capture volumes provided in this table are based upon a SWMM model for the combined sewer system that was validated and calibrated using data collected during an extensive field monitoring program.
7) As the CSO evaluation report is intended to be a "living document", the capture volumes provided in this table will be updated to reflect the current information available at the time of each facility plan or design update.
8) Percent Capture refers to combined sewage captured for treatment at Metro and elimination of combined sewage overflows for separation areas.

TABLE 2-6
ONONDAGA COUNTY CSO PROGRAM EVALUATION REPORT
CSO VOLUME CAPTURE TABLE - FUTURE CONDITIONS (Treatment at Metro and RTF'S)

Sewer Service Area/ Proposed Facilities	Average Annual Combined Sewage Volume Conveyed to Metro for Treatment (Million Gallons) [1]	Average Annual Additional Combined Sewage Volume Eliminated or Captured for Treatment at Metro or a RTF (Million Gallons) [2]	Total Annual Combined Sewage Volume Eliminated or Captured for Treatment at Metro or a RTF (Million Gallons) [3=1+2]	Total Annual Combined Sewage Volume Generated by the Metro Combined Sewer Service Area (Million Gallons) [4]	Percent Capture for Treatment at Metro and the RTF's [5=3/4]
Hiawatha RTF	116	24	140	140	100%
Harbor Brook In-Water System	638	143	781	810	96%
EBSS Upgrade	0	220	220	289	76%
Teall Ave. FCF	77	0	77	84	92%
Midland RTF	728	322	1,050	1,050	100%
Clinton RTF	720	142	862	862	100%
Franklin FCF	683	0	683	766	89%
Maltbie FCF	69	0	69	90	77%
Sewer Separation Areas	95	33	128	128	100%
Total	3,126	884	4,010	4,219	95%

Notes:
1) The capture volumes for the Hiawatha RTF also reflect the additional flow conveyed to Metro by the Kirkpatrick Street Pump Station Upgrade.
2) The basis of design for each regional facility is the 1-year, 2-hour duration design storm using 15-minute rainfall intervals, with the exception of the Harbor Brook In-Water System which is based upon 1/2 of the 1-year, 2-hour design storm using 15-minute intervals. The EBSS is based upon the 90 percentile storm.
3) During dry weather conditions, there is no flow from the EBSS to the Main Interceptor Sewer. Capture volumes reflect re-activation of the EBSS.
4) The capture volumes for Midland RTF includes the Newell Street flows.
5) The capture volumes reflect the separation of 212.8 acres of combined sewer service area, as listed in the ACJ.
6) The estimated capture volumes provided in this table are based upon a SWMM model for the combined sewer system that was validated and calibrated using data collected during an extensive field monitoring program.
7) As the CSO evaluation report is intended to be a "living document", the capture volumes provided in this table will be update to reflect the current information available at the time of each facility plan or design update.
8) Percent Capture refers to combined sewage captured for treatment at Metro and elimination of combined sewage overflows for separation areas.
9) Treatment at Metro is equivalent to a minimum of primary treatment followed by disinfection, while treatment at the RTF's consists of preliminary treatment followed by disinfection to meet water quality compliance.

2.4 Metro Capacity Analysis

The national CSO policy requires that CSO treatment at the treatment facilities be maximized as part of the overall CSO abatement plan. During implementation of the Best Management Practices (BMPs), the County closed or modified a number of overflows to direct as much wet-weather flow to Metro as feasible. The BMP CSO improvements completed in the mid 1980s resulted in a 90% volume reduction in the average annual discharge of CSOs in the system. Additionally, the ACJ requires that flows from the Kirkpatrick Street Pump Station (KSPS) flows be directly discharged to the Metro Headworks, thereby alleviating a hydraulic restriction that prevents utilization of the full pumping capacity of the pumping station. During development of the KSPS 30% design report, the County requested that the design consultant (EEA) and M&A confirm the ability of the Metro Headworks to accept the additional flow from the KSPS and determine the best location for its discharge. As part of the headworks analysis, the consulting engineers, investigated the maximum influent flows from all sources including MIS, HBIS, Ley Creek PS, West Side PS, and Liverpool PS.

During the headworks investigation and analysis the following tasks were undertaken:

- An assessment of the capacity of the Main Interceptor Sewer and specifically the frequency and duration of overtopping at the Spencer Street bypass

  An assessment of the theoretical capacity of the different headworks

  An assessment of the capacities of the different tributary sources to Metro

  An evaluation of the frequency of flow bypasses at Metro based on actual records

  A wet-weather flow management plan that will control the discharges from the KSPS, Hiawatha trunk sewer, and Hiawatha Regional Treatment Facility to minimize the potential for Metro bypassing

The analyses concluded the following:

The Spencer Street bypass overtops approximately 9 times per year. The principal cause is restrictive capacity downstream at the lower siphon crossing.

The capacity of the MIS is approximately 120 mgd at the lower siphon crossing.

The best location to tie in the proposed KSPS force main is on the upstream side of the Existing Screenings and Grit (ESG) Building

The actual frequency of wet-weather flow bypassing at Metro is once every five or six years. The proposed KSPS upgrade would have little impact on the frequency or magnitude of flow bypassing at Metro

A wet-weather flow management plan for the KSPS service area would be able to largely control Metro flow bypass situations

The existing tertiary clarifiers at Metro are currently being evaluated for storage or treatment of excess flows from the KSPS service area and those flows in the northern portion of the Harbor Brook basin.

2.5 SWMM Technical Review

The first CSO Evaluation Workshop identified a need to conduct a technical review of the Onondaga County Combined Sewer System Model development, calibration, and utilization. A Technical Review Committee (TRC) was formed for this purpose.

TRC objectives were to review the Stormwater Management Model (SWMM) approach, formulation, assumptions and application for adequacy in supporting the Onondaga County CSO program. The technical review was conducted through a series of meetings and conference calls in April and May of 2000. The TRC reviewed the following:

- Background of the CSO system,
- Model development history,
- Hydrologic and hydraulic characterization,
- Abatement planning results,
- Model Updates,

  TRANSPORT/EXTRAN model training,
- RDI/I and calibration documentation, and
- Model simulation.

A memorandum detailing this technical review is presented in Appendix E.

The CSO evaluation team and TRC identified a number of additional areas for model expansion and specific recommendations for model improvements, which are summarized as follows:

- Prepare a documentation report that describes the history and development of the hydraulic and hydrologic models.
- Expand the EXTRAN and TRANSPORT models to include the Spencer St. bypass, Lower Crossing siphon and connection of Harbor Brook and MIS systems with the METRO screen and grit chambers.
- Expand the RUNOFF models to include all separate sanitary areas tributary to the MIS and Harbor Brook collection systems.

- Investigate the impact of EXTRAN and RUNOFF expansions – noted above – on CSO abatement facility one-year design storm hydrographs.

- Perform and document additional model comparisons (model projections versus measured CSO data) for CSO outfalls, the Lower Crossing siphon, and inflows to Metro.

- Develop a list of potential sites for installation of rain gages to support future model analysis, calibration, and facility operations.

- Compare intensity-based estimates of CSO discharges at the Spencer St. bypass using hourly and 15-minute rainfall records when reliable data exists for both databases.

- Compare and document EXTRAN and TRANPORT CSO discharge volumes and captures for a one-year, 1991, simulation.

- Verify separate sanitary sewer service area delineation's tributary to the MIS and perform sensitivity analyses of the RD on model-estimated CSO discharges at downstream regulators.

  Prepare documentation of the details and assumptions behind the model setup, development, applications, and results.

A detailed description of the components of the recommended report are included in Appendix E. The general recommendations are also included in this appendix . Several of these recommendations have already been implemented.

It has been concluded that the existing SWMM model is adequate for the purposes of developing planning level CSO abatement strategy and technologies for Onondaga Lake and tributaries. There are no obvious or systematic problems with the development, calibration, or utilization of the SWMM. However, it must be modified and expanded in order to reliably measure CSO system performance and water quality response to CSO improvements. The observations and recommendations noted above will better predict and substantiate the calculated response of CSO to wet weather. The implementation of specific recommendations is not expected to significantly change the design parameters of the County's proposed CSO facilities – although this expectation should be tested.

2.6 Bacteria Model Technical Review

The Onondaga Lake bacteria model was used to evaluate the system-wide bacterial impacts on Onondaga Lake of the proposed CSO Abatement Program identified in the ACJ. An event-based fecal coliform bacteria model was developed and calibrated by Upstate Freshwater Institute (1987) to allow the projection of Onondaga Lake bacteria concentrations from wet-weather discharges associated with the CSOs. The model was later improved to accommodate continuous simulation to be more useable as a predictive tool. In addition, the model incorporated measured data from the CSOs throughout the collection system. The model allows inputs from the major tributaries into Onondaga Lake. These tributaries include Onondaga

Creek, Harbor Brook, Ley Creek, Ninemile Creek, East Flume, Trib. 5a., Bloody Brook, and Sawmill Creek.

The federal CSO Policy allows for four overflow events per year with a provision for the permitting agency, in this case NYSDEC, to permit two more events per year. However, the ACJ specifies that CSOs will be abated such that all remaining overflows are provided with treatment up to and including the one-year frequency storm. The ACJ also specifically requires compliance to the bacterial standards in "Class B" waters of the Lake.

The acknowledged dry-weather standard for "Class B" states that a fecal coliform bacteria violation exists when the logarithmic mean of colony forming units (cfu) exceeds 200 cfu/100 ml over a period of five consecutive days or 1000 cfu/100ml for any measurement. Presently, New York State has not developed wet-weather standards. The ACJ states that *"the CSO discharges remaining after implementation of the CSO Control and Upgrade Program do not cause or contribute to conditions in violation of water quality standards or impair the designated best uses of the receiving waters".* (p.12, ¶14)

For the purposes of this evaluation, a bacteria violation is defined as when Lake concentrations exceed 200 cfu/100 ml on an instantaneous basis. Bacterial model projections of bacterial concentrations in the Lake assuming completion of the CSO abatement program demonstrated compliance throughout the "Class B" sections of the Lake.

A memorandum presenting the details of the bacteria projections is presented in Appendix B.

The USEPA recently released the Draft Guidance for entitled "Implementing the Water Quality Based Provisions of the CSO Control Policy" for public review and comment. A preliminary review of this document indicates that Total Maximum Daily Loads (TMDL's) and water quality monitoring may play a significant role in the evaluation of the performance of a Community's CSO Abatement Program. In consideration of the provisions contained in this draft document, it would be prudent to perform a thorough review of the proposed requirements and evaluate their implications related to the County's CSO Abatement Program.

3.0 Alternative Technology and Approaches Review/Evaluation

3.1 Currently Proposed Technologies/Approaches

As described in Section 2, the ACJ requires the County to achieve the following relative to abating its CSOs.

A. elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis;

B. elimination or minimization of floating substances in Onondaga Lake attributed to County CSOs; and

C. achievement of water quality standards for bacteria for all portions of Onondaga Lake that are classified as "Class B" pursuant to 6 NYCRR Part 895.

The ACJ CSO abatement program projects intended to achieve the above standards employ several technologies and approaches as briefly described below.

Sewer separation.

Sewer seperation will result in the elimination of CSOs within the tributary service areas scheduled for sewer separation. The existing CSOs will either be permanently closed or converted to a stormwater-only discharge as part of the sewer separation process.

Regional storage with post-storm treatment at Metro.

Regional storage with post-storm treatment at Metro will include storage of CSO flows including the first flush up to the regulatory-approved design storm condition. CSO flows in excess of the design storm condition would continue to discharge to the receiving waters without treatment. Following the storm event, the stored flows would be conveyed to the Metro plant for at least primary treatment prior to final discharge.

Regional high-rate treatment for settleable solids and floatables removal, followed by effluent disinfection for bacterial reduction.

The regional high-rate treatment facilities are intended to address floatables capture, settleable solids to reduce disinfection demands and bacterial reduction, as well as incorporate supplemental CSO capture/storage to the extent practical. Critical to the implementation of these facilities is the ability to achieve adequate bacterial reduction of CSO flows prior to discharge to permit compliance with the water quality standards for bacteria as specified in the ACJ.

Regional floatables capture/removal.

Regional floatables capture/removal will maximize floatables capture for the CSOs scheduled for this abatement approach. The captured floatables will be removed and disposed of off-site. Net-bag facilities were constructed and are currently operational at Maltbie Street (CSO 066) and the Franklin area (CSOs 020 and 021). A mechanical "combing type" screen has been designed for construction at Teall Brook (CSO 073). In addition to the above point source floatables control facilities, interim regional facilities are currently being designed for Onondaga Creek and Harbor Brook. The Onondaga Creek facility will consist of a boom, while the Harbor Brook facility will consist of a floating in-stream net bag system. These "interim" regional facilities will be installed for the purposes of providing floatables control facilities until the upstream CSO Abatement plans are fully developed and implemented. The screened CSOs will continue to discharge to the receiving water bodies (i.e., Harbor Brook, Onondaga Creek, or Ley Creek) without further treatment. These collective discharges do not have a consequent impact on the "class B" waters.

An evaluation of various technologies for settleable solids and floatables removal prior to disinfection for bacterial reduction was performed as part of the County's 1991 CSO Facilities Plan (1991 Plan). The 1991 Plan determined that vortex solids separators, and, in particular, the EPA's swirl regulator/concentrator, provided the most efficient demonstrated removal of settleable solids and floatables for high-rate treatment operations. Vortex Separators were, therefore, incorporated into the ACJ as the technology for the regional high-rate treatment facilities followed by disinfection. The 1991 Plan also recommended high-rate disinfection using liquid sodium hypochlorite; however, the ACJ included provisions for demonstration testing of various disinfection alternatives to permit selection of the most appropriate high-rate disinfection technology for County CSOs. The final report of the alternative disinfection testing has not been completed, but the conclusion of the study was that sodium hypochlorite with dechlorination was the only feasible disinfection system for high-rate-disinfection of combined sewage.

In order to insure that best, most cost-effective and appropriate technology is applied to the CSO abatement program, the County directed its engineers and project managers to undertake an updated review of high-rate treatment technologies. A summary of this updated review of alternative high-rate treatment technologies is presented in the following section.

3.2 Updated Review of Technologies/Approaches

3.2.1 Preliminary Screening of Treatment Technologies/Approaches

The purpose of this section is to review and describe the various treatment technologies that may be considered applicable to the treatment of CSOs and to conduct a preliminary screening of those technologies to determined those that are most feasible and subject to further evaluation (intermediate screening) in meeting the requirements of the ACJ for regional control of CSOs. In order to satisfy the ACJ treatment requirements described previously, high-rate disinfection in conjunction with one or more combinations of potentially applicable treatment technologies will still be required.

The following sections provide a brief description of each treatment technology, and/or abatement approach identified, and its ability to be utilized to provide floatables, settleable solids and, in some cases, enhanced pollutant removals for biochemical oxygen demand (BOD), total suspended solids (TSS), total keldahl nitrogen (TKN), and total phosphorus (TP).

A. Vortex Separators:

Vortex separators remove floatables and settleable solids by directing the flow tangentially into a cylindrical tank, creating a vortex. The vortexing action tends to concentrate settleable solids toward the center of the tank and removes the concentrated solids through a foul sewer outlet located at the bottom of the tank. The influent flow travels under a scum plate that captures floatables and retains them until the tank empties after the storm-event; the flow then spills over a circular weir located in the center of the tank. The vortex separator has no moving parts and is designed to operate under extremely high flow conditions.

It has been reported that vortex separators are capable of removing up to 90 percent of settleable solids, up to 35 percent of TSS and BOD; some nominal removals of TKN and TP (between 5 and 15 percent) have also been reported. In some applications, no power is required for operation of the unit as the influent and underflows may be conveyed by gravity through the vortex separator. Depending on the available hydraulic head, pumping of the vortex influent flows or the underflows may be required. If influent flows require pumping, large capacity pumps are required. Operation and maintenance requirements are low since the majority of the captured settleable solids and floatables are discharged into the foul sewer during and immediately following the storm event.

Due to its solids and floatables removal efficiency, low operation and maintenance requirements, and proven performance in CSO applications, the vortex separator technology is considered to be appropriate for further evaluation for CSO treatment. Schematics of the three types of vortex separators are shown in Figure 3-1.

B. Enhanced Vortex Separators:

Enhanced vortex separators include the use of dissolved air floatation or physical-chemical flocculation additives to enhance the operation of the vortex separators. To date, this technology has only been demonstration-tested in one location (Scarborough, Canada) at low operating/loading rates. Results of this testing have demonstrated slightly enhanced removal efficiency in the vortex separator. However, these results occurred at low operating/loading rates and it was reported that a lengthy start-up time was required to stabilize the operation prior to achieving the enhanced removals.

Due to the fact that all CSO treatment facilities will be required to operate at fairly high loading rates due to the peak flow characteristics of the storm events and that a period of time is required to stabilize the system, this technology is not considered appropriate for this project.

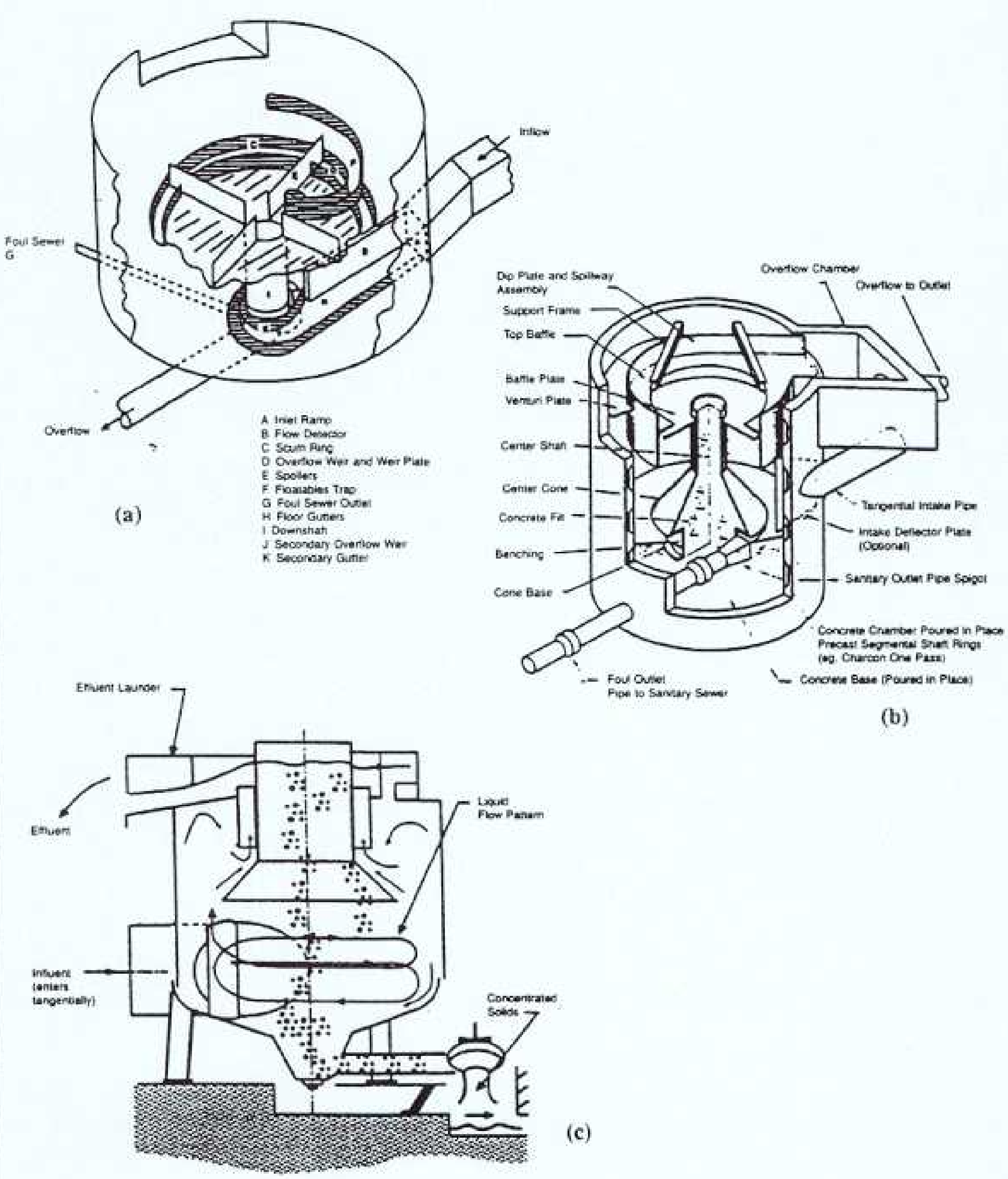


Figure 9.46 **Vortex separator schematics: (a) U.S. swirl concentrator, (b) U.K. Storm King vortex solids separator, and (c) German Fluidsep vortex solids separator.**

Source: Prevention & Control of Sewer System Overflows, WEF Manual of Practice No. FO-17 Second Edition, 1999

Lake Improvement Project, Onondaga County, New York

Onondaga County CSO Program Evaluation Report

Vortex Separator Schematics

Figure 3-1

C. Continuous Deflective Separation (CDS):

Continuous deflective separation (CDS) is a variation of the vortex separator technology. The CDS consists of a cylindrical tank, which utilizes a physical barrier, typically, a fine screen, between the influent flow and outlet discharge. Flows enter the CDS tank tangentially and are deflected from the discharge by entering a deep sump. Flows are conveyed into the center of the sump and must pass through a screen before proceeding to the discharge. The continuous swirling action in the sump causes heavier solids to fall to the bottom and keeps them away from the screen, thereby eliminating the need for a cleaning mechanism. However, solids accumulated in the bottom of the sump must be removed at the conclusion of a storm event. The CDS manufacturer also reports that periodic removal of solids from the sump during storm events may be required to prevent these solids from accumulating too densely and blocking the discharge screen.

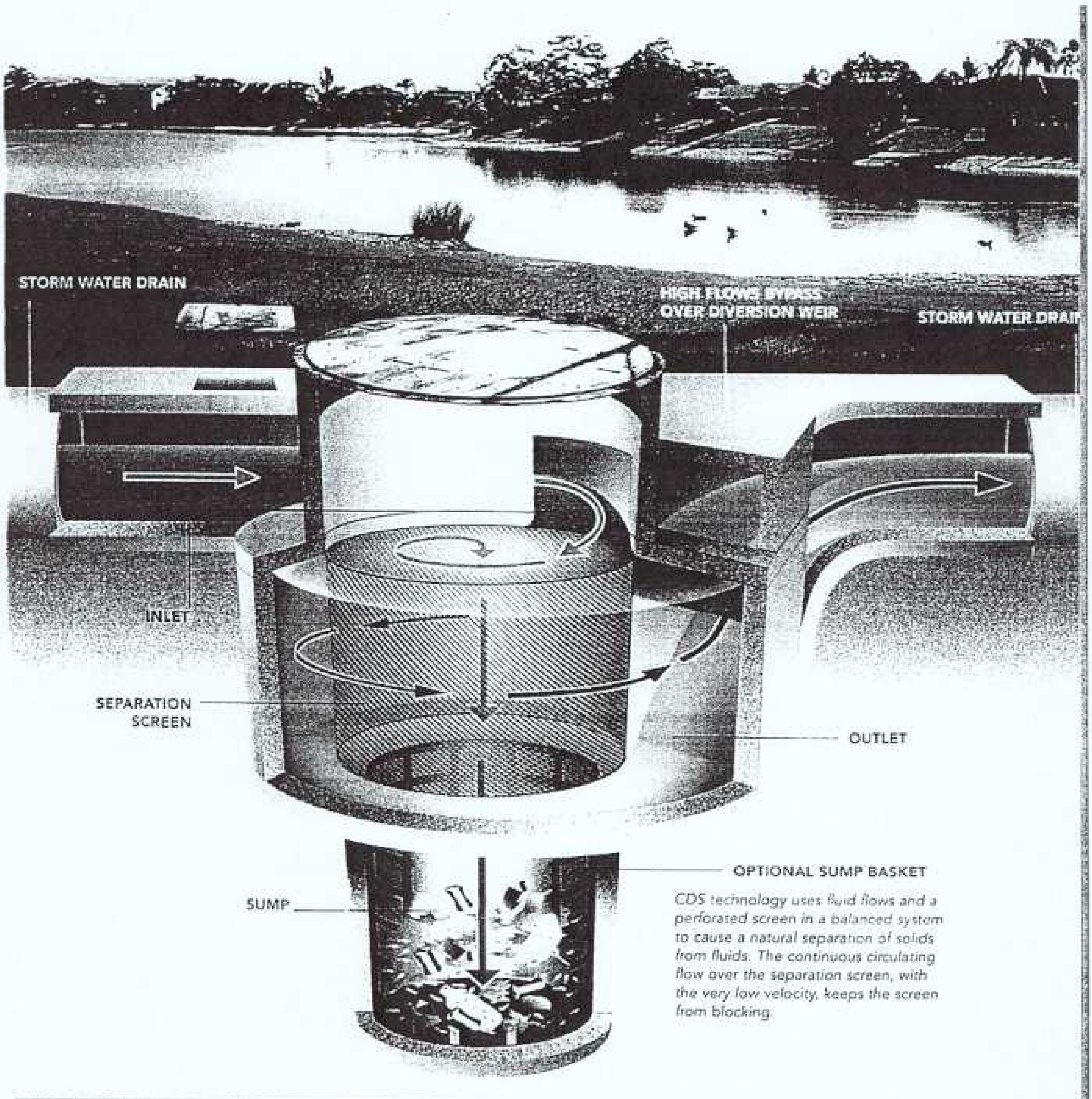
Since the screen provides openings of less than 1/6-inch, this technology is capable of removing small solids and floatables as well as TSS (reported to be up to 10 percent). Operation and maintenance of this system includes disposal of the collected solids at the conclusion of (and possibly during) the storm event. This can be accomplished by installing sump-pumping facilities, using a clamshell bucket, or a vacuum truck. Operation and maintenance requirements are generally limited to solids removal following (and possibly during) a storm event and properly cleaning the screen following the storm event. Figure 3-2 provides a schematic of this process.

Due to its capability to remove floatables and smaller solids, this technology is considered to be appropriate for further evaluation for under the County's CSO Program.

D. Ballasted Flocculation:

Ballasted flocculation is a high-rate coagulation and sedimentation treatment process that introduces flocculation and coagulation agents during high speed mixing to promote settlement and enhance solids removal. In the process, flow enters the first zone of the facility where a coagulating agent is added and mixed with diffused air. The coagulating agent is typically a metal salt or polymer. The flow then enters the second zone where a flocculating agent together with a flocculating aid, either recirculated sludge or microsand, is added. In this area, intense mixing occurs to promote the formation of suspended floc particles. The flow then enters the settlement zone where the dense flocs settle out and are concentrated at the bottom of the basin. Clarified effluent passes through an inclined or tube settlers plate to remove residual floc particles, and the final effluent is discharged. The concentrated solids are either recycled back to the second zone or wasted. Concentrated solids from technologies utilizing sand as a flocculating aid are conveyed through a separation process where the sand is separated from the waste solids and recycled back into the process or stored for future flow events. A schematic of the high-rate flocculated settling system is included as Figure 3-3. Photos of this process are incorporated as Figure 3-4.

A significant consideration of this process is the amount of land that is occupied. Figure 3-5 presents an aerial view of the Midland site with the outlines of ballasted flocculation and



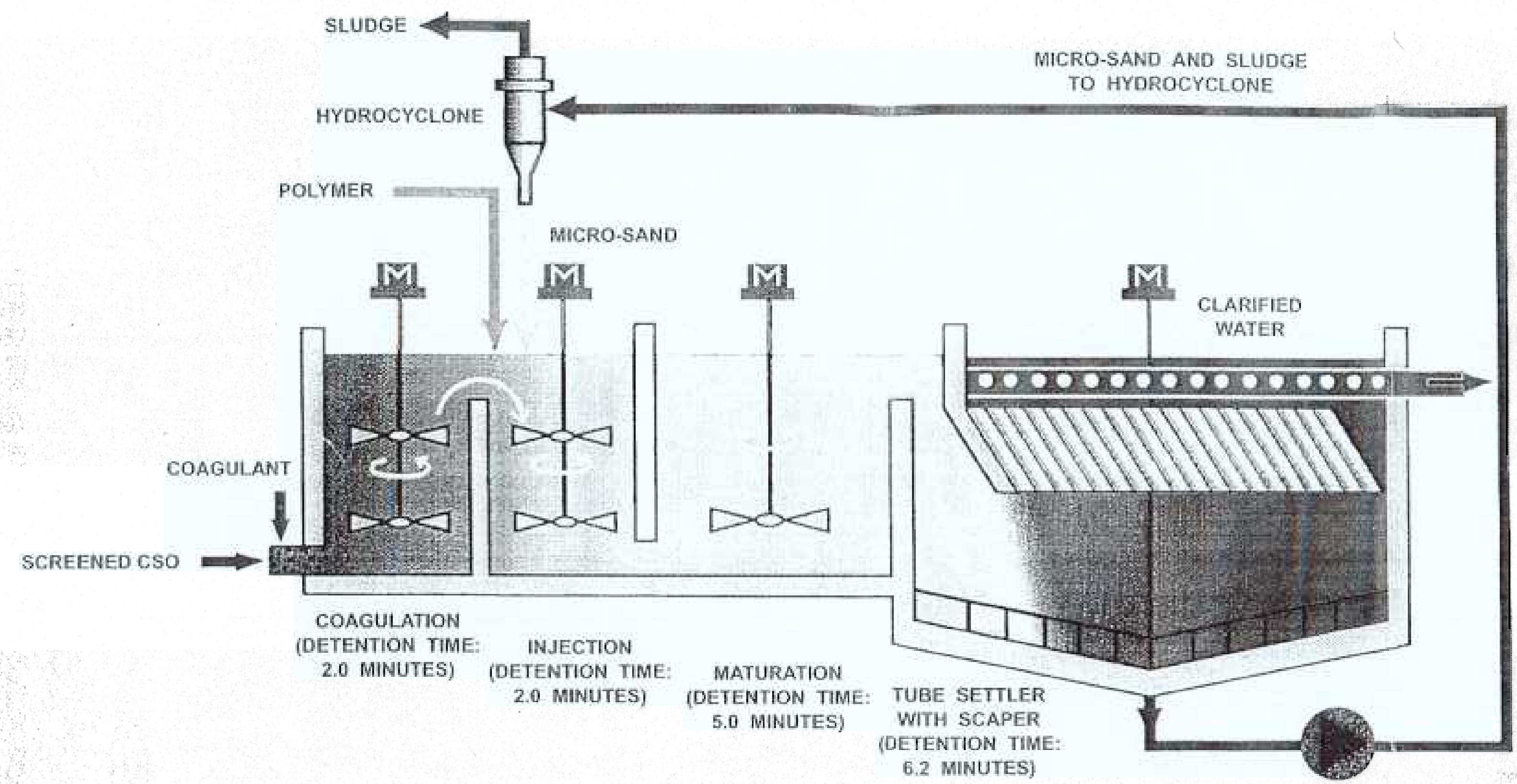
Lake Improvement Project, Onondaga County, New York

Onondaga County CSO Program

Evaluation Report

Continuous Deflective Separation

Figure 3-2



PRELIMINARY
APRIL 28, 2000

NOTES:
1) Figure taken from Actiflow7, (Kruger, Inc.).
2) Designed detention times based upon verbal recommendations from Actiflow7 sales representative, similar to unit sizing for METRO Stage II Phosphorus Removal Project.

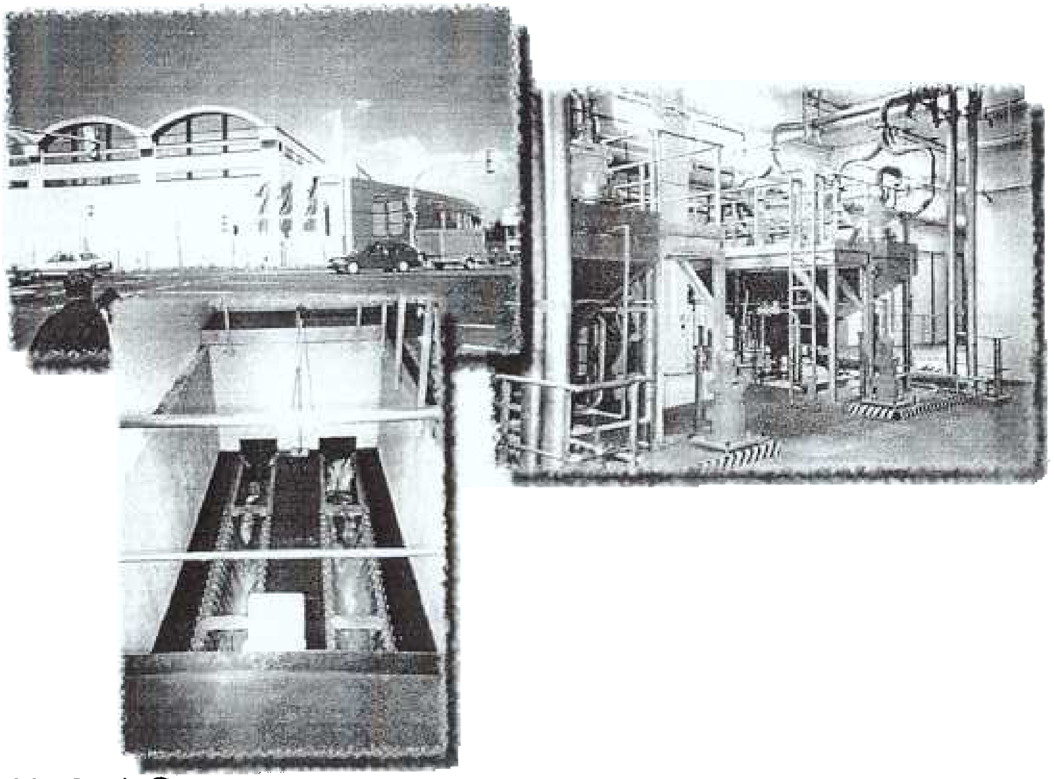
ENVIRONMENTAL ENGINEERING ASSOCIATES, LLP
SYRACUSE, NEW YORK

ONONDAGA COUNTY
DEPARTMENT OF DRAINAGE AND SANITATION
LAKE IMPROVEMENT PROJECT OFFICE

HIGH RATE FLOCCULATED SETTLING SYSTEM

FIGURE **3-3**

04/00 SYR-D54-DJH
05567011/05567g01.CDR



Herford, Germany

Capacity: 12 mgd

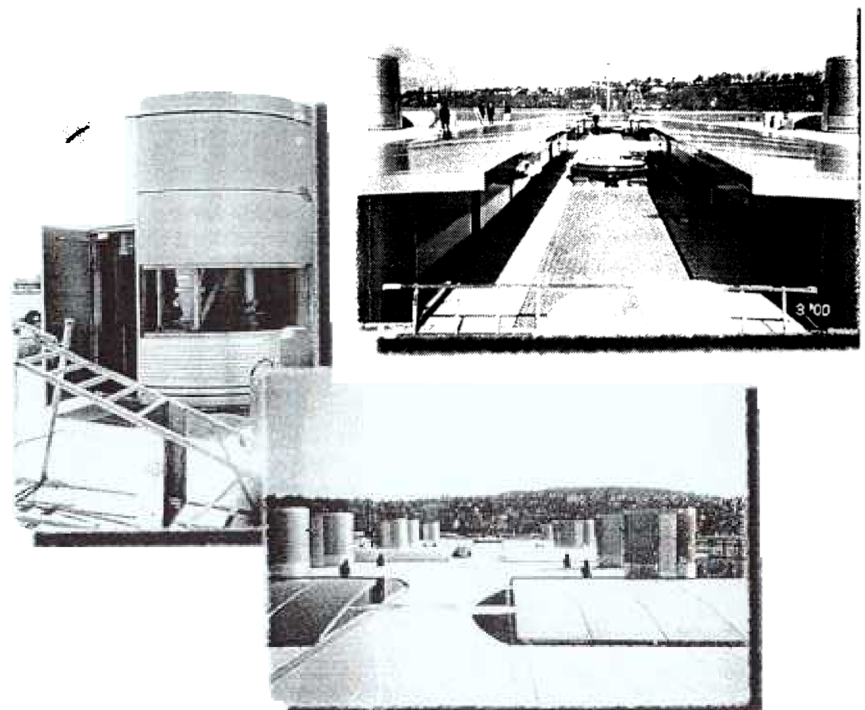
Process Technology:
ACTIFLO: Phosphorus removal, effluent polishing

HRFS Specifics:
- Two ACTIFLO units
- Rise rate 55 gpm/ft with one unit out of operation
- 60 mg/1 FeCl3
- 1 mg/1 polymer dose
- Sand replacement: 3.3 lbs./million gallon

Seine Aval Wastewater Treatment Plant
Acheres (Western Suberb of Paris), France

Capacity (ACTIFLO System):
500 mgd wet wether flow: 340 mgd dry

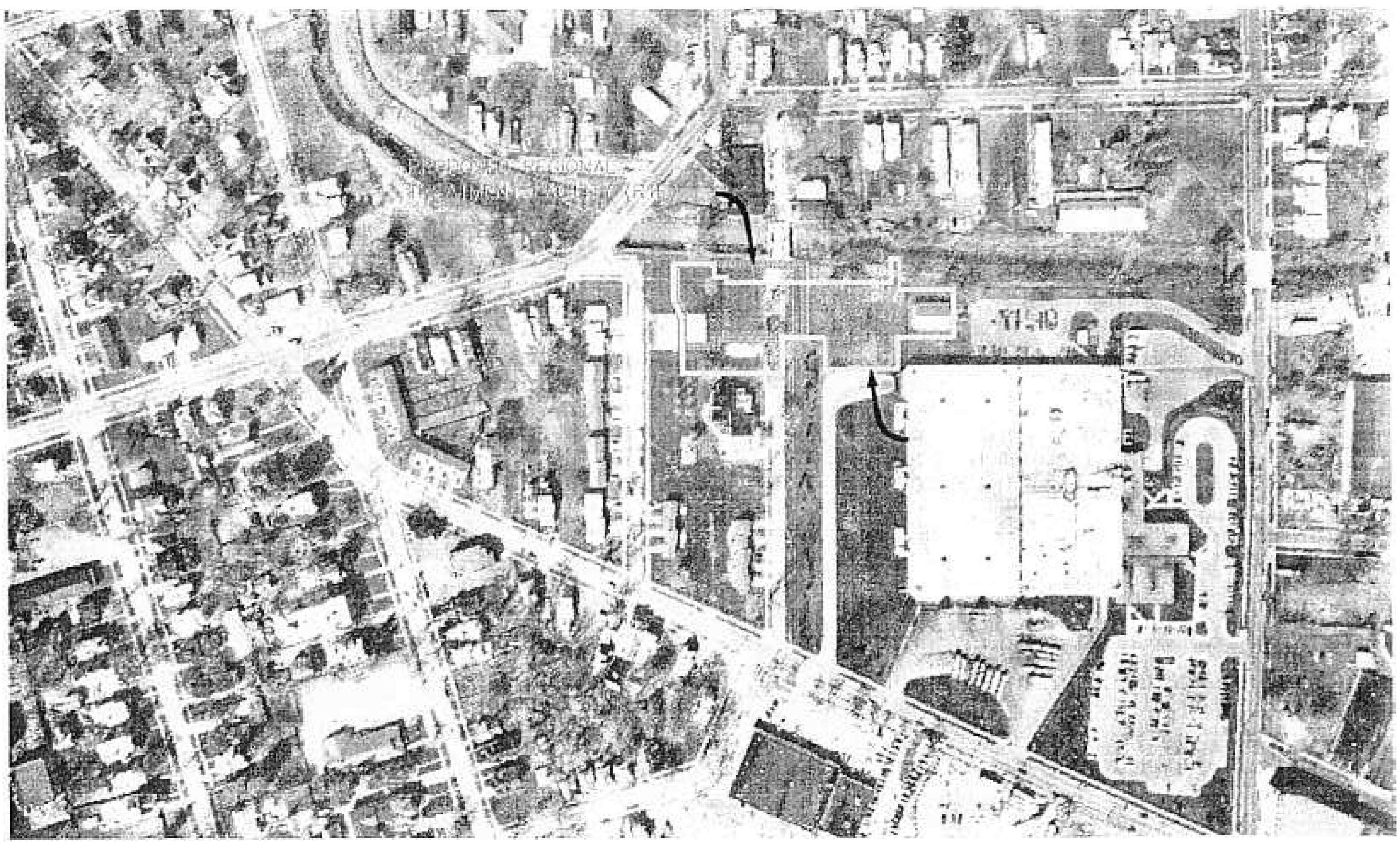
Process Technology:
ACTIFLO: 6 units



Lake Improvement Project, Onondaga County, New York
Plant Profile
Figure 3-4

Midland Avenue Regional Treatment Facility

Figure 3-5



NOTE:
BASE MAP GENERATED FROM AERIAL PHOTOGRAPH (DATED 4/27/92) AT AN APPROXIMATE SCALE OF 1"=100'

PRELIMINARY
APRIL 27, 2000

Environmental Engineering Associates, LLI
Syracuse, New York

swirl concentrator facilities. Blowups of these two processes are provided as Figures 3-6 and 3-7, respectively. It can be seen that a significant portion of the space for the ballasted flocculation facility is associated with the high-rate flocculation settling and sludge processing components.

Ballasted flocculation has been reported to be capable of removing nearly 100 percent of settleable solids, up to 84 percent of TSS, 54 percent of BOD, 25 percent of TKN, and 90 percent of TP in CSO applications. However, it is reported that the system requires approximately 10 to 30 minutes startup time in order to stabilize before it is able to accomplish the above-stated pollutant removal efficiencies. In addition, preliminary screening of solids greater than 1/6-inch-diameter is required before the flow is treated with ballasted flocculation. The operation and maintenance concerns associated with the technology are high, considering the requirements for large quantities of chemicals, solids processing and recycling, and high energy consumption during a storm event.

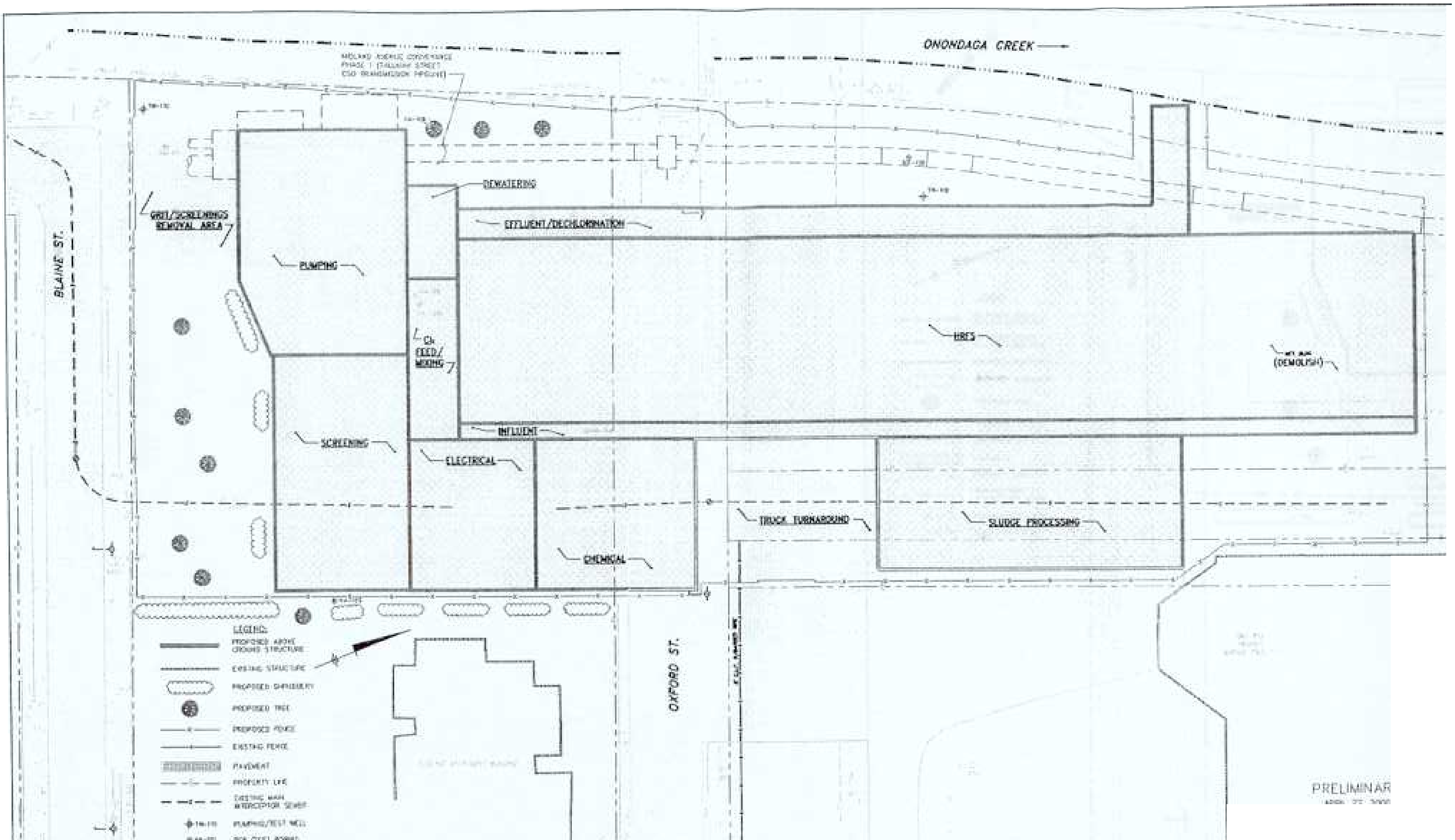
The ballasted flocculation system provides a high degree of treatment, but due to the time required to stabilize the system and its high operation and maintenance requirements, this technology is not considered appropriate for this project.

E. Coarse Screening:

A coarse screening device consists of vertical or inclined bars typically spaced greater than 1-inch, which remove floatables, rags, sticks and solids greater than the bar opening by capturing them on the bars. Influent flow travels perpendicular to and through the bars. Debris that is too large to pass through the openings is retained on the bars and removed by manual or mechanical raking arms. Screens placed in CSO applications are subject to rapid blinding; therefore, mechanically cleaned bar screens are necessary for effective operation. Photos of a coarse screen are shown in Figure 3-8.

Coarse screens are used with proven results at raw sewage pumping stations and headworks of wastewater treatment plants to prevent large objects and stringy materials from damaging downstream pumps and process equipment. Several CSO coarse screening installations exist in the United States; however, most are used as preliminary treatment devices to protect downstream processes. Operation and maintenance requirements for intermittently operated coarse screening devices are fairly high and, typically, the coarse screening facility will require additional attention at the conclusion of a storm event. Since minimal BOD and TSS removal is accomplished by the screens, additional provisions may be required to remove these pollutants in order to achieve target bacterial reduction limits, as both BOD and TSS impart their own disinfectant demand in wastewater.

Due to its small space requirements in relation to other CSO technologies and proven floatables and solids removal efficiency, this technology is considered to be appropriate for further evaluation under the County's CSO Program.



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In charge of
Designed by
Drawn by
Checked by

...al Engineering Associates, LLP
Syracuse, New York

County of Onondaga Department of Drainage and Sanitation • Syracuse, New York
MIDLAND AVENUE REGIONAL TREATMENT FACILITY
SITE PLAN
HIGH RATE FLOCCULATED
SETTLING SYSTEM

File Number
666.54

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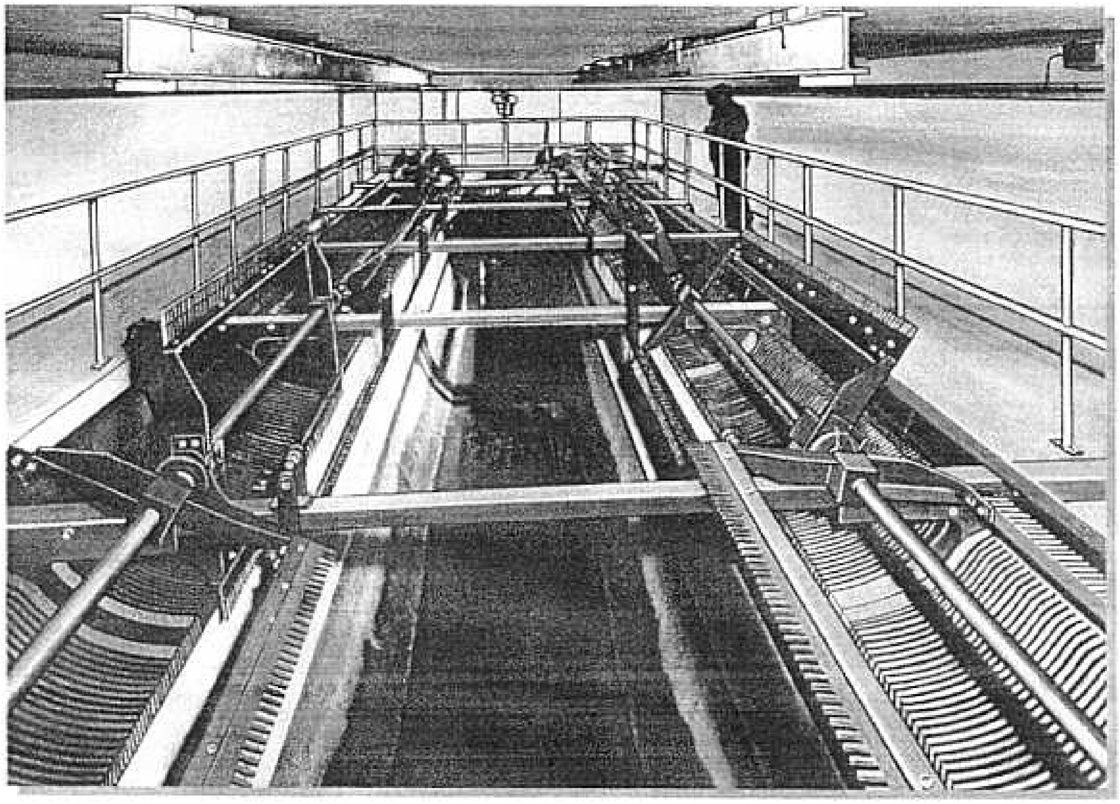
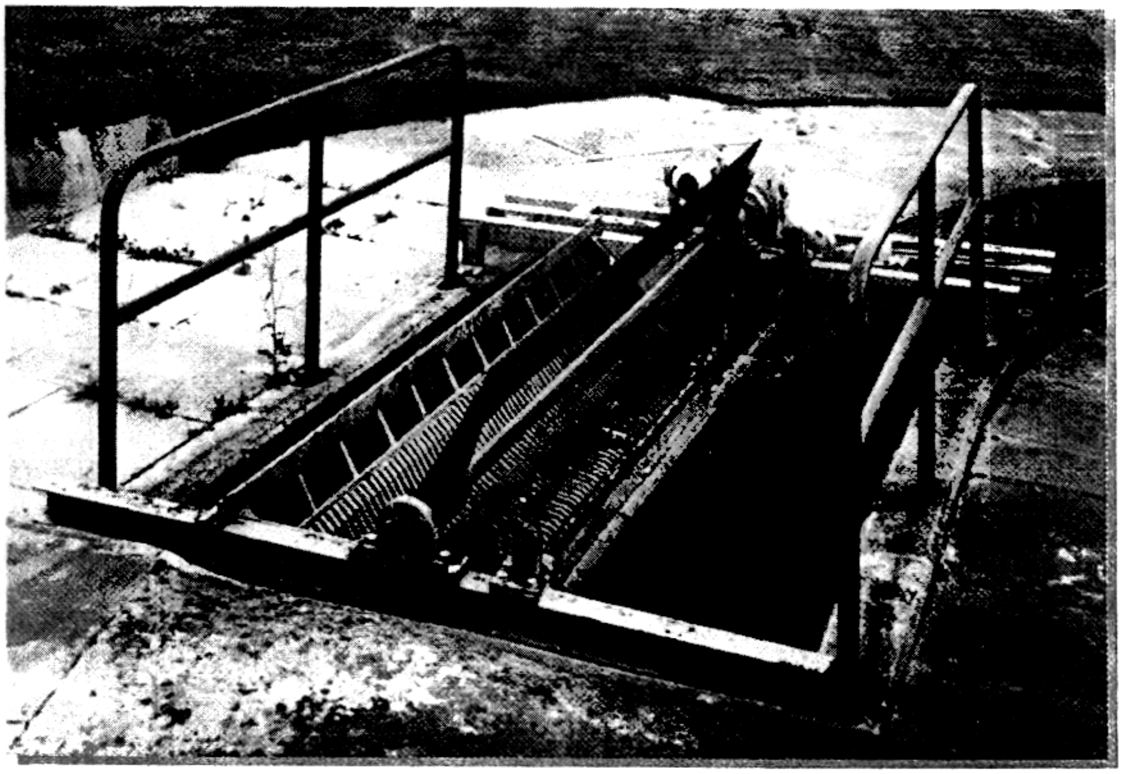




Lake Improvement Project, Onondaga County, New York

Onondaga County CSO Program
Evaluation Report

Coarse Screening Device

Figure 3-8

F. Fine Screening:

Fine screens are similar to coarse screening devices with the exception that they remove smaller size solids by capturing them on a bar screen with openings typically less than 1-inch and greater than 1/6-inch. Fine screens are continuously cleaned by a mechanical raking device, and captured solids are either removed or directed to a foul sewer for disposal. Similar to coarse screens, fine screens are proven devices in removing floatables and solids from a flow stream. The screens can be situated either horizontally or vertically, depending on the manufacturer. Operation and maintenance requirements can be significant, as the facility may need additional attention for equipment maintenance/cleaning at the conclusion of a storm event. Since minimal BOD and TSS removal is accomplished by fine screens, additional provisions may be required to remove these pollutants in order to achieve target bacterial reduction limits, similar to coarse screening. Fine screens will be provided to remove floatables and gross solids for the Teall Brook discharge (CSO 073) and may be incorporated into other locations. Examples of fine CSO screens are provided in Figure 3-9.

Due to its small space requirements in relation to other CSO technologies and proven floatables and solids removal efficiency, this technology is considered to be appropriate for further evaluation under the County's CSO Program.

G. Brush Screens:

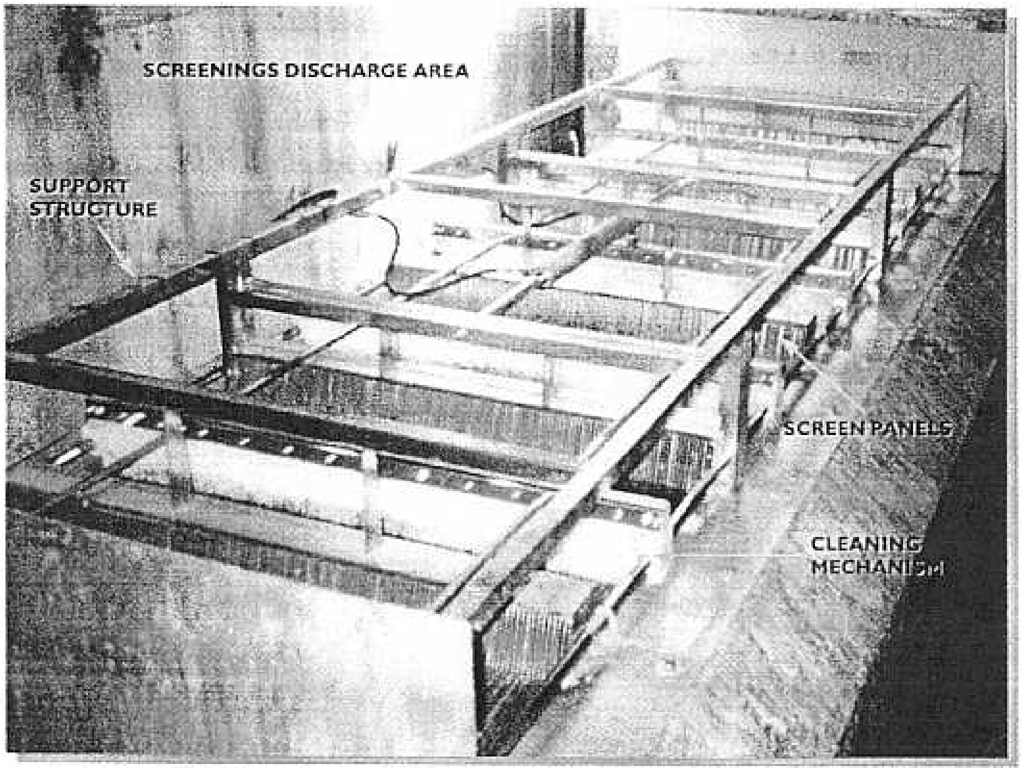
A brush screen is a relatively new innovation for solids removal. The screen consists of fine bristles which provide effective solids removal down to 4 millimeters (1/6 inch) in diameter. The brush screen is mounted horizontally on a center shaft that rotates countercurrent to the flow being treated. The rotating brush is cleaned by a fixed comb that directs captured solids into a collection trough. Figure 3-10 shows the operation of a brush screen.

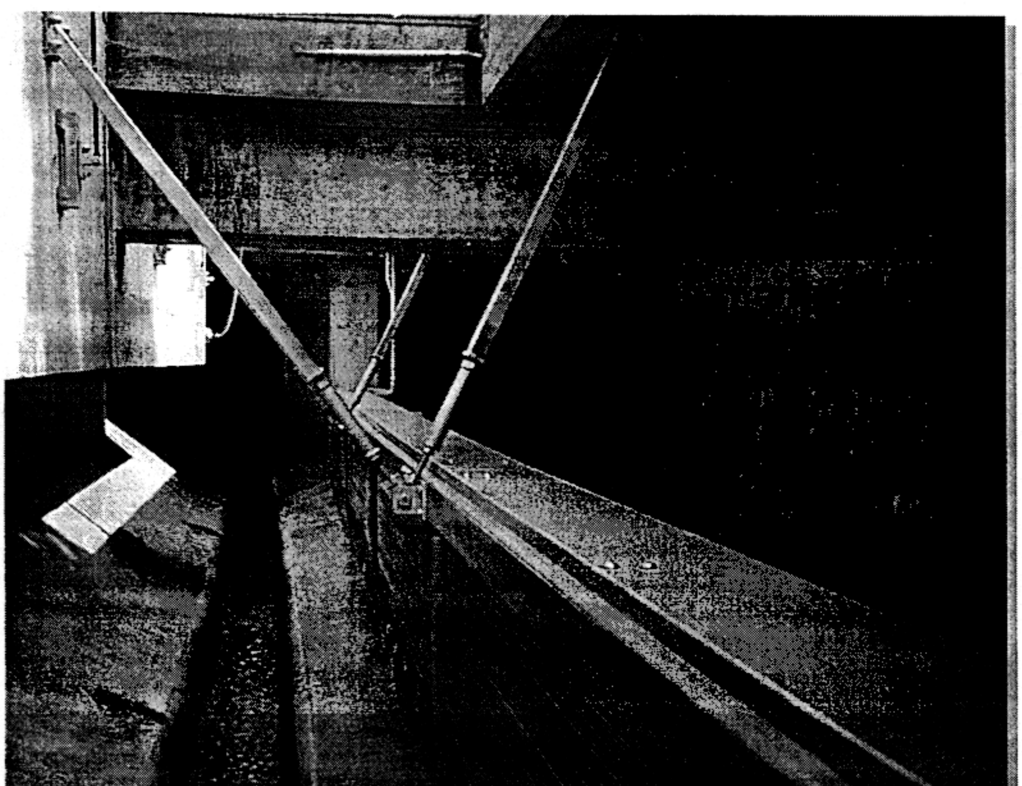
Brush screens have been applied to CSOs in Europe and are reported to be somewhat effective at removing floatables and solids from the waste stream. There are currently no operating installations in the United States treating CSOs. Operation and maintenance requirements are fairly high, however, as the brush screen is reported to have a tendency to capture and retain stringy materials that ultimately wrap around the shaft making cleaning difficult.

Due to the limited operating experience of brush screens for CSO treatment and the tendency to accumulate stringy materials and create a potentially significant maintenance issue, this technology is not considered to be appropriate for this project.

H. Rotary Drum Screens/Sieves:

Rotary drums and sieves remove solids by passing flows through a rotating screen. Flows can be introduced from either the interior or the exterior of the rotating drum, depending on the manufacturer. Rotary drums that receive flows from the exterior screen the flow as it passes through a perforated drum or sieve, retaining captured solids on the outside of the rotating drum. The screened flow is then discharged and the retained solids are either





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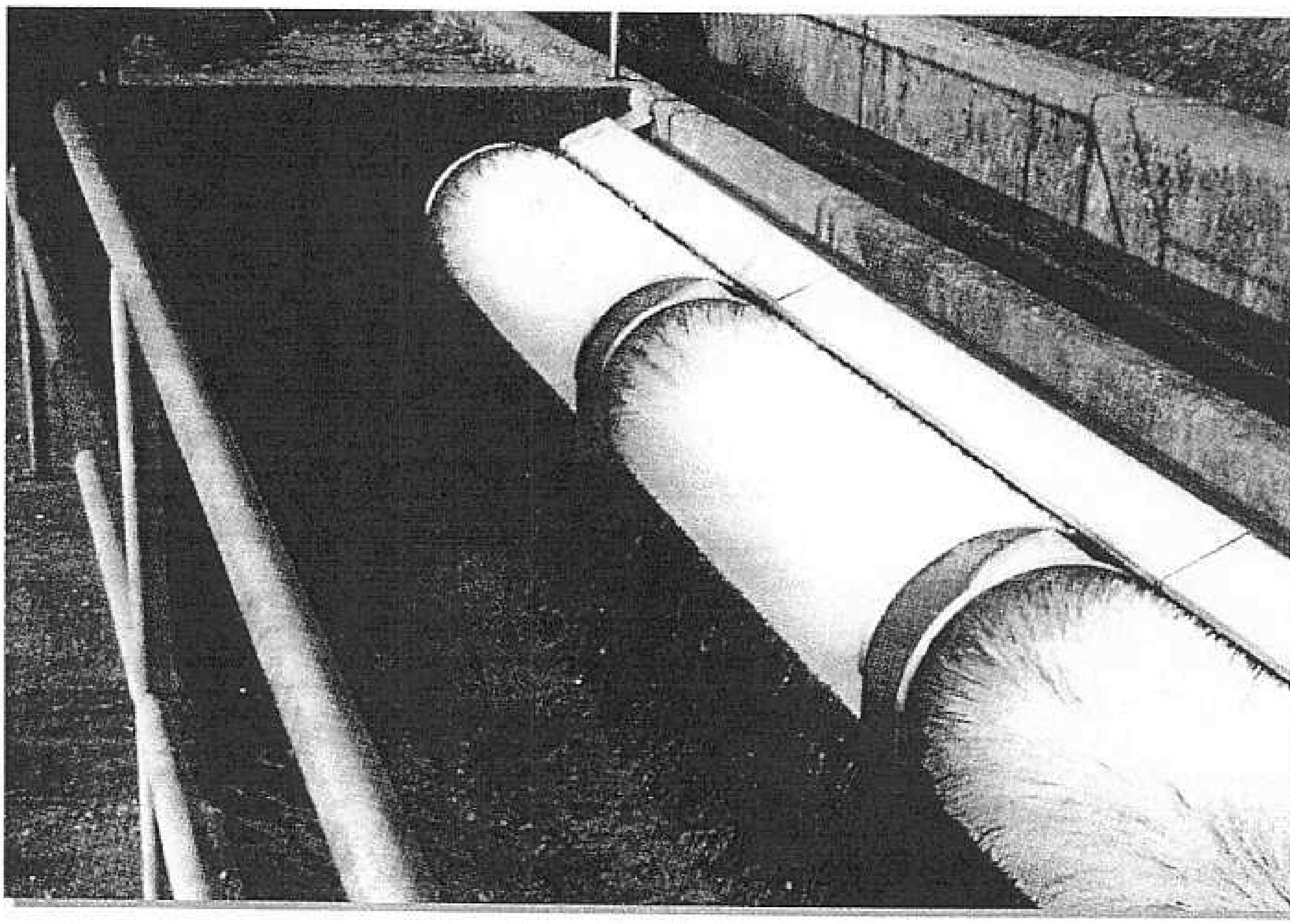
Onondaga County CSO Program Evaluation Report

Fine Screening Device

Figure 3-9



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Onondaga County CSO Program

Evaluation Report

Brush Screens

Figure 3-10

scraped or scoured off into a collection trough. Rotary drums that receive flow from the interior of the drum, screen the flow as it passes through a perforated drum or sieve, leaving captured solids on the interior of the rotating drum. The drums are typically inclined to promote migration of the captured solids to a disposal trough.

Rotary drums and sieves remove solids greater than 2 millimeters in diameter; therefore, a coarse screening device is required to precede the rotary drum in order to prevent larger solids from collecting on and blinding the drum. Some rotary drums have experienced rapid blinding due to hair pinning. Hair pinning occurs from fibrous material becoming interwoven with the drum perforations or wire sieves creating maintenance problems. In order to maintain a clean screening surface, a continuous high-pressure water wash is required during a screening event. Due to the rotary drums' small openings, it has been reported that up to 20 percent of influent TSS and BOD can be removed through use of this technology. An example of a rotary drum screen has been included as Figure 3-11.

In consideration of the removal efficiencies for smaller sized solids and the ability to remove gross pollutants, this technology is considered to be appropriate for further evaluation for under the County's CSO Program.

I. Microscreens:

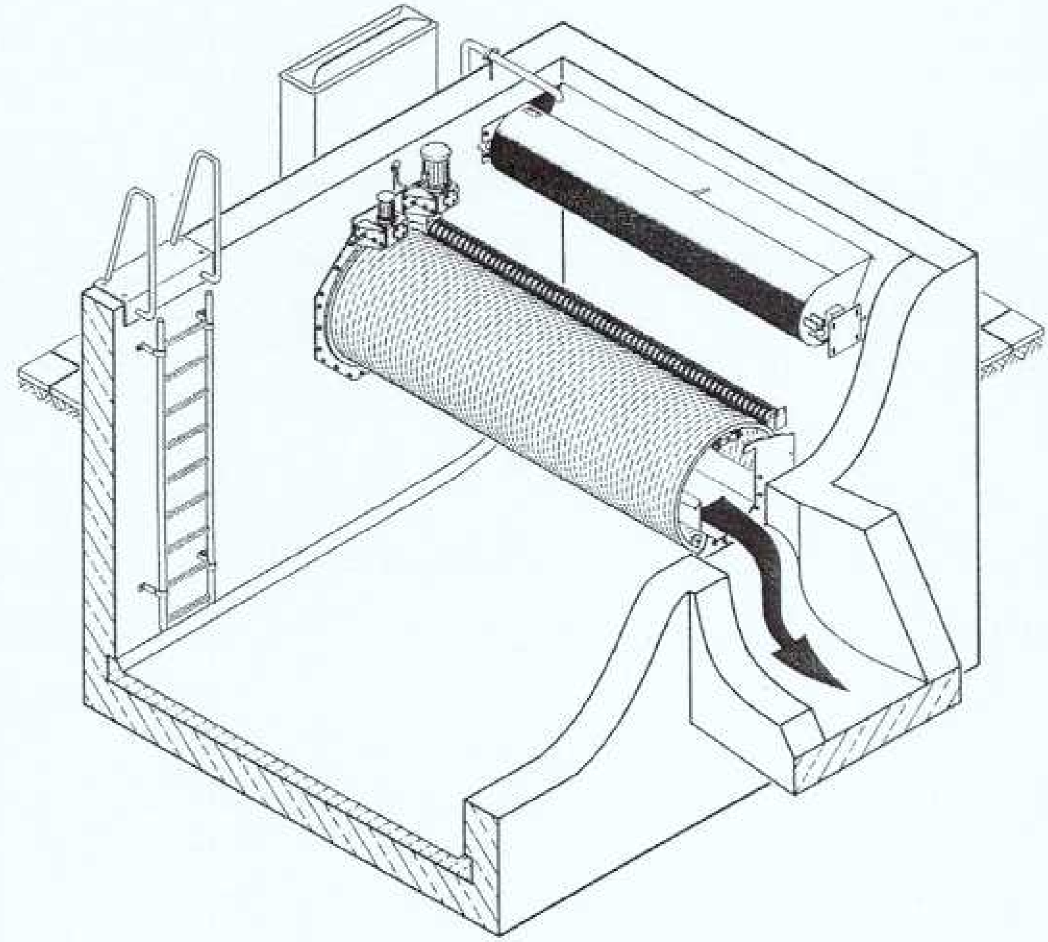
Microscreens are used to remove fine particles from a flow stream. They consist of a rotating horizontal drum with a cylindrical surface made of a fine screen or a fabric mesh. The flow enters from inside of the drum and flows outward in a radial direction. Screens are cleaned by using pressurized filtered flow to backwash the screens. Screens are sized from 6-74 microns (.00023-inches to .00289 inches) and mesh from 20-330 openings per linear inch. A coarse or fine screen would need to be installed prior to the microscreen to prevent the microscreen from rapidly blinding.

Due to its ability to remove extremely small particles from the flow stream, the microscreen is able to remove up to 80 percent of settleable solids, 55 percent of TSS, and 50 percent of BOD. However, operation and maintenance of the microscreen would be significant due to the large quantity of screenings that would be generated and the expected blinding of the screen in a CSO application. Energy consumption is also expected to be high due to the number of drums that would be required and the motor horsepower requirements.

Since microscreens are not manufactured for use in CSO treatment and have high operation and maintenance concerns, this technology is not considered to be appropriate for this project.

J. Net Bags:

Net bags are fabric nets that are placed in the flow stream to capture floatables and larger solids. The bags typically have an opening of 1/2-inch and can contain up to 25 cubic feet of material (per bag). The bags are placed horizontally in the channel and can be stacked in both the horizontal and vertical directions to accommodate large flow requirements.



Lake Improvement Project, Onondaga County, New York
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Evaluation Report
Rotary Drum Screen
Figure 3-11

Net bags are capable of removing solids greater than 1/2-inch; however, they are not capable of removing significant gross pollutants, such as TSS, BOD, TKN, or TP. Since BOD and TSS removal by net bags is generally considered to be minimal, additional provisions may be required to remove these pollutants in order to achieve target bacterial reduction limits, similar to coarse and fine screening.
Operation and maintenance requirements for net bags, as experienced by the County at two existing installations, are high due to the labor required to remove, dispose, and replace the net bags after each storm event. There are no power requirements associated with this technology; however, specially designed hoisting equipment and adequate facility access for net bag removal are required.

Net bags are an acceptable technology for isolated end-of-pipe facilities (such as the Maltbie Street Facility) and in locations where mechanical screening of the flow does not permit the ready direction of screenings to the interceptor sewer (such as both Franklin FCFs).

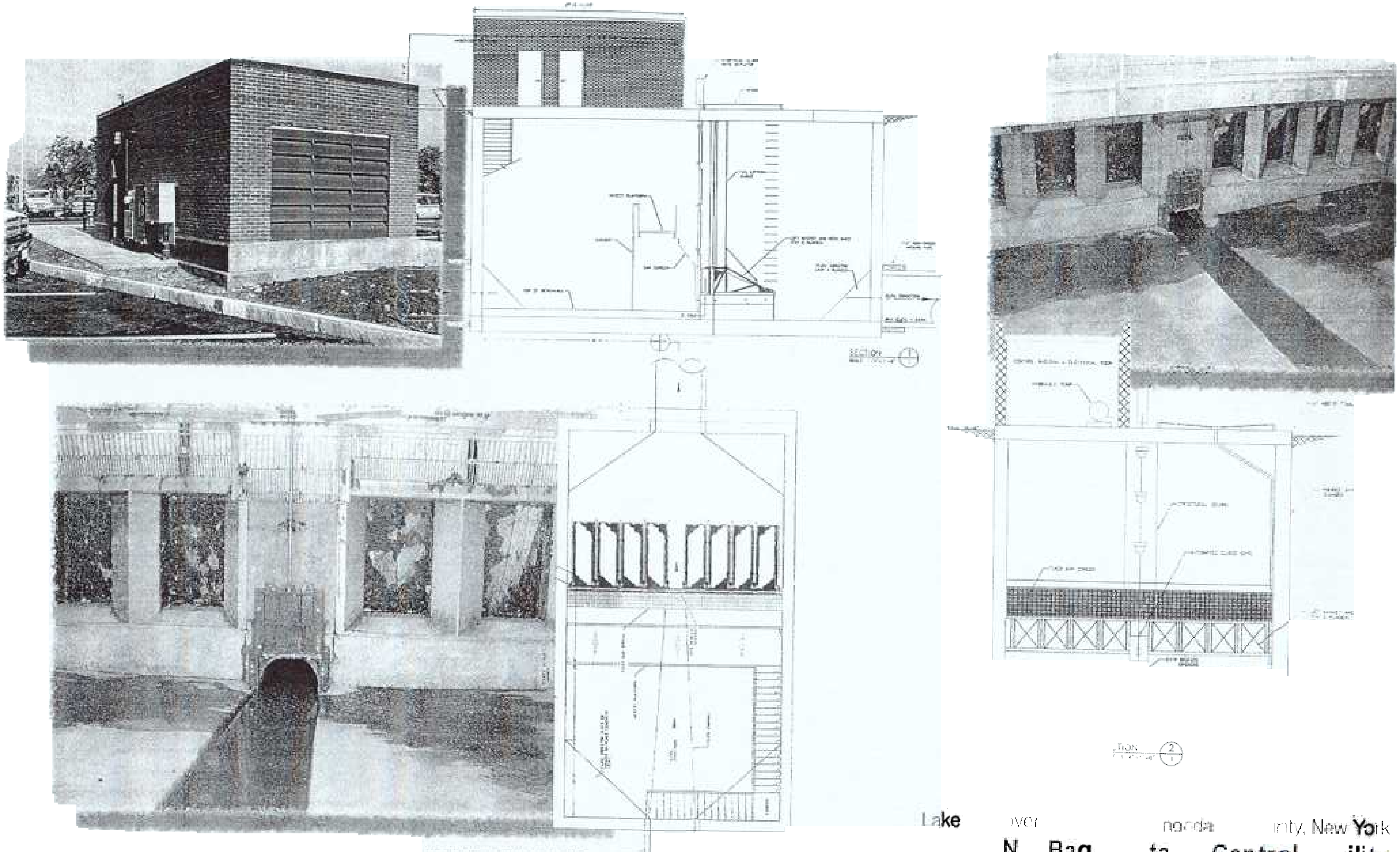
Due to the highly intensive labor requirements necessary to remove, dispose, and replace the net bags from the facility and the anticipated need to provide additional treatment technology to achieve target bacterial reduction limits, this technology should only be considered as a measure for floatables control for CSO treatment where disinfection is not required and other technologies/approaches will not work. Figure 3-12 provides a schematic with photos of the Franklin net bag facility.

K. Overflow Retention Facility (ORF)

An overflow retention facility (ORF) can act as both a storage tank and a high-rate sedimentation tank. An ORF is generally sized to retain a volume equal to a specific storm. This may be the volume associated with the "design storm" (which in the case of Onondaga County facilities is the 1-Year, 2 hour storm with 15 minute peak rainfall intensities). Once that volume is exceeded, the tank will act as a high-rate primary sedimentation facility with detention time to provide effective solids and floatables removal. The volume remaining in the tank at the conclusion of a storm event would be conveyed back to the municipal wastewater treatment plant for treatment.

It has been reported that up to 90 percent of floatables, 80 percent of settleable solids, 50 percent of TSS, and 35 percent of BOD can be removed through this technology. Captured flow that is subsequently conveyed back to the municipal wastewater treatment plant will have even higher gross pollutant removal efficiencies. Operation and maintenance requirements associated with this technology include cleaning and flushing of the basin at the conclusion of a storm event, and moderate power use from pumps to return flow to the sewer system.

Since the ORF has generally moderate operation and maintenance requirements and has the ability to achieve effective floatables, solids, and gross pollutant removals, it is considered to be appropriate for further evaluation under the County's CSO Program.



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Alternative Approaches

L. Regional Conveyance and Treatment:

Regional conveyance and treatment can provide a cost-effective means of treating CSO discharges from multiple overflow points. Piping is required to divert overflows to a central, or regional, treatment site. While land requirements may be sizable for a regional facility, the routing of the conveyance system may be designed to transport the overflows to a suitable site. This provides increased flexibility in site selection and reduces the number of neighboring properties that are impacted, which is often difficult in urban areas. Regional facilities usually provide cost advantages by reducing the number of parcels of land to be acquired and the consolidating construction, operation and maintenance (O&M) activities to a single site.

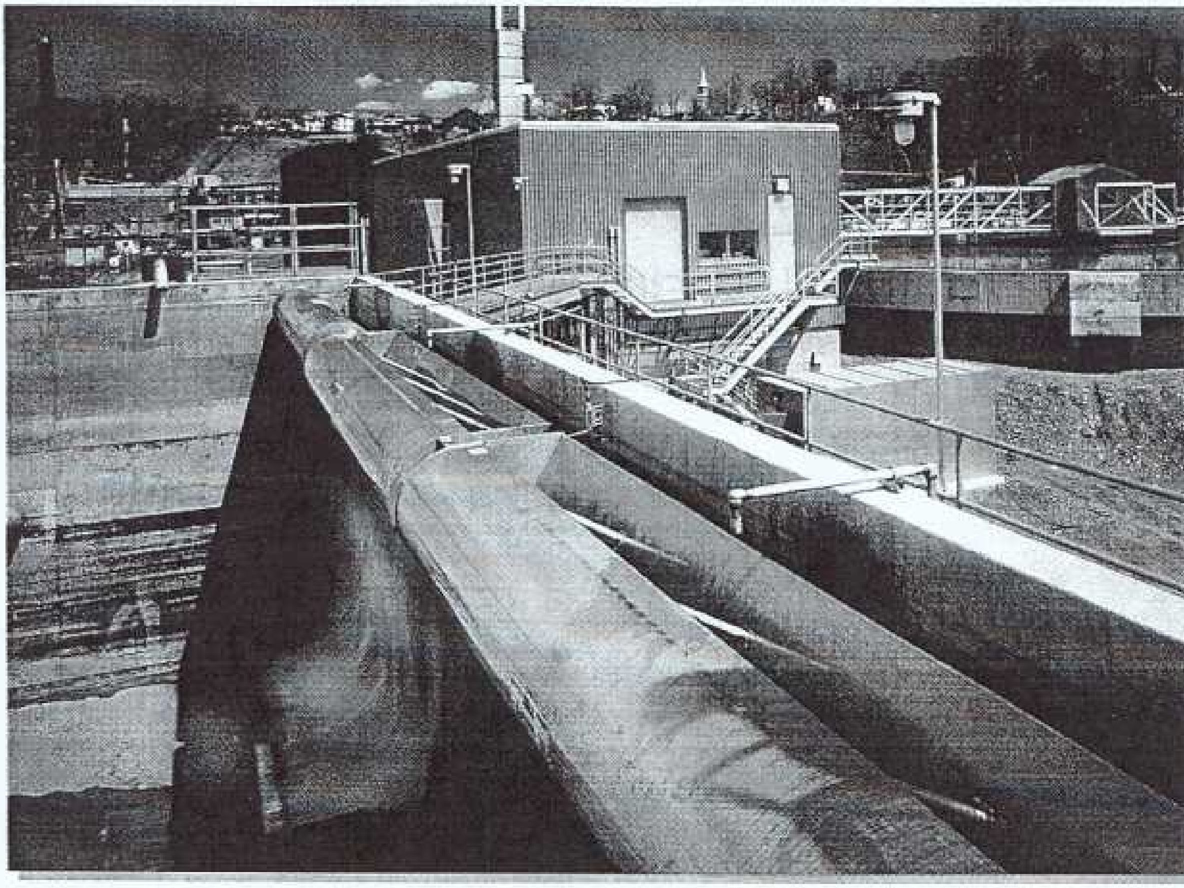
Although the ultimate performance of the facility is dependent upon the treatment process utilized, disinfection results may be improved through low loading rates and greater contact times which can be more readily accommodated by a larger facility. Regional facilities also have the advantage of flexibility in handling a wide range of flow rates from different size storm events. The conveyance system may also be oversized to attenuate flows and reduce the size of the regional treatment facility.

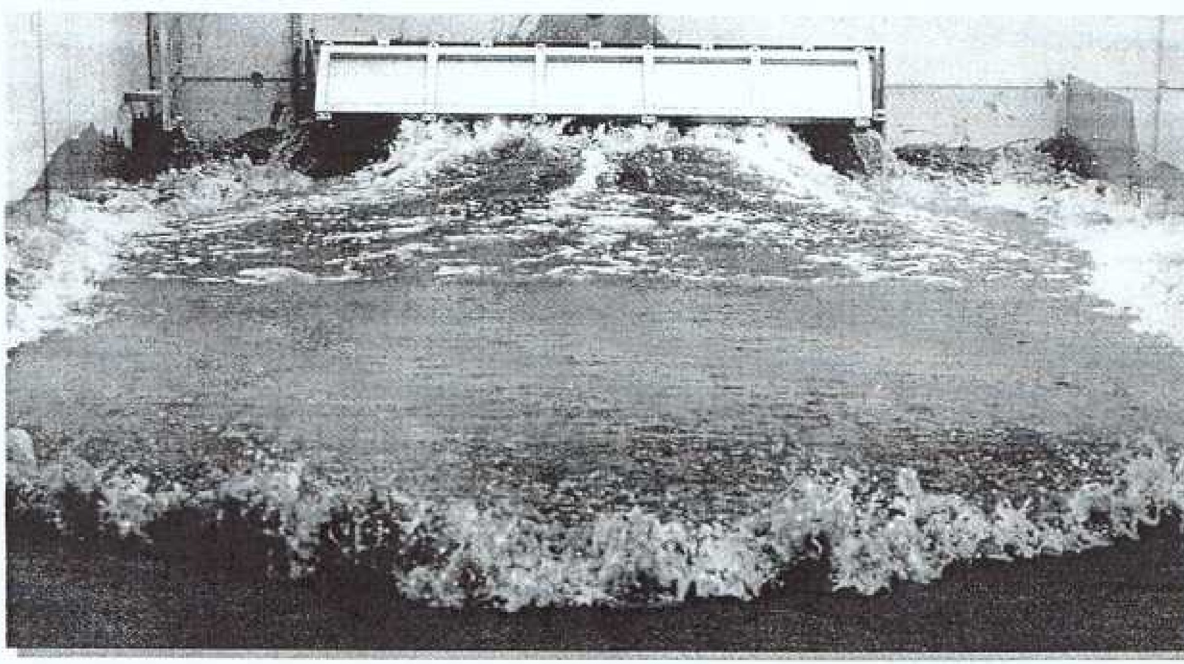
M. Regional Storage:

Regional storage includes the capture of wet-weather flow from single or multiple CSOs in a particular CSO drainage area or region. Following the storm event, the stored CSO volume would be discharged to the municipal wastewater treatment plant for full secondary or tertiary treatment. Due to the large volume of wet-weather flow, regional storage facilities may be large in size. Siting of these facilities in urban areas may be difficult because of lack of land on which to construct them.

Storage facilities may be appropriate for the control of specific pollutants and can be very beneficial in the reduction of annual CSO discharge volume. Since the approach does not provide treatment of wet-weather flows directly, the technology is not feasible if it is required to treat back-to-back storms. Recent storage applications incorporate tipping bucket or other flushing mechanisms for the removal of solids from the tank bottom following dewatering. Care must be taken to site storage facilities only in those locations where downstream interceptor or trunk sewers are not subject to sedimentation.

Figure 3-13 shows two different types of sediment flushing devices for storage tanks or for use in overflow retention facilities. Both of the devices shown have proven effective in the removal of sediment following tank dewatering. One unit uses the "dam-break" method of sediment scouring where a flap gate is tripped and stored water rushes across the base of the tank. The second is a "tipping bucket" unit where, once filled, the unit rotates by gravity and flushes the tank.





Lake Improvement Project, Onondaga County, New York

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Evaluation Report

Storage Tank Flushing Units

Figure 3-13

N. Centralized Storage/Treatment at Metro:

This approach includes collecting all service area CSOs for a design storm event prior to discharge and conveying the captured CSOs to the Metro plant for storage and subsequent treatment at Metro. This approach provides the highest degree of pollutant removal for CSOs, as the captured and stored CSO discharge could receive secondary, and advanced treatment at Metro. Similar to regional storage, this approach may not provide back-to-back storm event protection unless it is set up like an ORF facility with supplemental treatment and/or disinfection. One alternative for the abatement of CSO discharges in the northern (lower) portion of the Harbor Brook basin would involve "centralized storage/treatment" at Metro.

The ability to capture all County CSOs and convey them to the Metro plant for storage and subsequent treatment was evaluated as part of the 1991 Plan. The 1991 Plan demonstrated conveyance of all County CSOs to the Metro plant for storage and treatment is not cost-effective and may not be physically feasible. However, due to the ability to potentially utilize the existing Metro tertiary clarifiers for CSO storage following the forthcoming installation of the ACJ-mandated ammonia and phosphorus removal facilities at the plant, this approach may be feasible for treatment of some specific CSOs that can be cost-effectively conveyed to Metro.

O. Sewer Separation:

The separation of combined sewers into separate sanitary and storm sewers is a historical method of eliminating CSO discharges. Separation normally requires the construction of a new sanitary sewer system parallel to the existing combined sewer system. The combined sewer system is then left in place to serve as a storm sewer, and all sanitary connections are switched over to the new sanitary sewer line. In effect, sewer separation is an abatement method that achieves a high degree of gross pollutant removal and provides a system that requires low operation and maintenance. While separation results in the elimination of the sanitary sewage component of the CSO discharge, the storm water component will continue to discharge pollutants associated with urban runoff, which may impact the program's ability to meet the water quality standards. Generally, sewer separation is most cost effective when applied to smaller CSO drainage basins. Major sewer separation projects can be very disruptive of urban neighborhoods, and separation of large drainage basins may require the construction of stormwater treatment facilities to meet current federal water quality regulations. For these reasons, sewer separation is considered to be appropriate for further evaluation for CSO abatement in appropriate areas.

A summary overview of the CSO treatment technologies described above, including typical performance characteristics, is presented in Table 3-1.

Those technologies and approaches considered to be appropriate for further evaluation for treatment of County CSOs, based upon the above preliminary screening assessment, are as follows:

TABLE 3–1

ONONDAGA COUNTY CSO EVALUATION REPORT
OVERVIEW OF CSO TREATMENT TECHNOLOGIES

Technology	Gross Pollutant Removal @ Peak Design Flow						Relative Power Use	Non-Disinfectant Chemical Use	Anticipated O&M	Potential Manufacturers	Comments
	Floatables	Settleable Solids	TSS	BOD	TKN	TP					
a. Vortex Separators	44-100% (material dependent)	90%	35%	15%	5%	5%	Low	None	Low	USEPA (Swirl), HIL (Storm King), GNA (Fluidsep)	• Lower reported floatables removal in HIL unit • Settleable solids and TSS removal dependent on influent solids settleability characteristics
b. Enhanced Vortex Separators	44-100% (material dependent)	>90%	60-65%	-	-	-	Medium	Polymer	Medium	USEPA (Swirl), HIL (Storm King), GNA (Fluidsep)	• Long start-up time • Dissolved air floatation and/or physical-chemical flocculation additives • Data limited to HIL unit at low loading rates
c. Continuous Deflective Separation (CDS)	100% >1 mm	100% >1 mm	10%	-	-	-	None	None	High	CDS Technologies	• Two U.S. installations, on-line January 2000 (Louisville, KY) currently being tested for CSO (previously used for stormwater only)
d. Ballasted Flocculation	None (requires preliminary fine screening)	100% (assumed)	69-84%	54%	25%	90%	High	Polymer, Ferric Chloride or Alum	High	Kruger (Actiflow), IDI (DensaDeg 4D)	• TSS and BOD removals based on pilot testing in NYC • Requires start-up period of 10-30 minutes • Provides more treatment than ACJ requirements • Requires preliminary fine screening • Requires staff
e.. Coarse Screening (Mechanically Cleaned)	>1"	Incidental	Incidental	Incidental	Incidental	Incidental	Medium	None	High	FMC, IDI, Envirex, Jeffrey, Fairfield	• May require additional TSS and BOD removal to achieve target disinfection level • Assumes screenings removed at site
f. Fine Screening (Mechanically Cleaned)	>1/6" (4 mm)	Incidental	Incidental	Incidental	Incidental	Incidental	Medium	None	Medium	Waste Tech (Cope), Waterlink (Romag), John Meunier (OS-LP)	• May require additional TSS and BOD removal to achieve target disinfection level • Assumes screenings retained and conveyed to MIS • Only one US installation (Chattonooga, TN [Cope])
g. Brush Screens	>1/6" (4 mm)	Incidental	Incidental	Incidental	Incidental	Incidental	Low	None	Medium	GNA (Hydroclean)	• May require additional TSS and BOD removal to achieve target disinfection level • Assumes screenings retained and conveyed to MIS • No US installations (one in Canada) • Potential rag collection on brushes
h. Rotary Drum Screens/Sieves	21 mm x 4 mm	-	18%	20%	-	-	Medium	None	High	Bracket-Green, Hycor (Rotoshear), John Meunier (Hydrovex RDS)	• Assumes screenings removed at site • Frequent replacements of screen panels • Requires preliminary coarse screening
i. Microscreens	100% (requires preliminary coarse screening)	80%	32-55%	10-50%	-	-	High	None	High	Envirex, Zurn	• Frequent blinding due to grease • Requires high pressure water jets to clean (10-15% of effluent flow)
j. Net Bags	>1/2" 90%	Incidental	Incidental	Incidental	Incidental	Incidental	None	None	Medium	Fresh Creek Technologies, Klargester	• Removal of net bags is labor intensive
k.. Overflow Retention Facilities (ORF)	>90%	80%	50%	35%	-	-	Medium	None	Medium	N/A	
l. Regional Conveyance and Treatment											• Removal rates dependent upon treatment technology utilized • Cost reductions due to consolidation of facilities
m. Regional Storage	100%	100%	95%	95%	95%	95%	Medium	None	Medium	N/A	• Provides no back-to-back storm event protection
n. Centralized Storage/ Treatment at Metro	100%	100%	95%	95%	95%	95%	None	None	Medium	N/A	• Provides no back-to-back storm event protection
o. Sewer Separation							None	None	Low	N/A	• Eliminates sanitary content from discharge. • Does not capture urban run-off contaminants

Alternative Technologies

- Vortex Separators
- Coarse/Fine/Rotary Drum Screening (screening technologies)
  Continuous Deflective Separation (CDS)
  Overflow Retention Facility (ORF)

Alternative Approaches

- Regional Conveyances and Treatment
- Centralized Storage/Treatment at Metro (for CSOs cost-effective to convey to Plant)
- Regional Storage (for special applications)
- Sewer Separation

3.2.2 Secondary Screening of Treatment Technologies and Approaches

A secondary screening of the preliminary-screened treatment technologies and approaches was conducted to further assess the capabilities of these technologies and approaches to meet the specific requirements of the ACJ.

The alternatives were compared on the basis of size, operation and maintenance considerations, ability to meet ACJ objectives, and performance. Performance criteria included floatables removal, settleable solids removal, TSS removal, BOD removal, and effect on CSO volume capture.

In order to satisfy ACJ bacteriological requirements, high-rate disinfection will be a required component of any of the selected CSO treatment technologies or approaches, with the exception of Centralized Storage/Treatment at Metro and Sewer Separation. Currently, there is not a great deal of performance data available regarding the disinfection of CSOs. However, based on the limited data base, TSS and nutrients have been demonstrated to have an effect on the disinfection of CSOs. These constituents can chemically react with the disinfectant and reduce its effectiveness as a bactericide. Additionally, constituents such as TSS can limit the exposure of bacteria to the disinfectant by harboring the bacteria within the solids.
Alternatives for minimizing the effects of high TSS and nutrient concentrations on disinfection performance include reducing TSS and nutrient concentrations, increasing disinfectant dose, and increasing contact time. Increased disinfectant dose and contact time do present some disadvantages such as increased capital and operation and maintenance costs. Additionally, if chlorine is used as the disinfectant, increasing chlorine dose will tend to increase disinfection by-products, such as total residual chlorine (TRC) and total trihalomethanes (TTHMs), which in turn generate concern regarding toxicity in the receiving water. In view of these disadvantages, it is preferable to reduce TSS and nutrient concentrations prior to disinfection.

Alternative Technologies

Screening Technologies

In 1979, EPA Research and Development report entitled "Disinfection/Treatment of Combined Sewer Overflows" was issued detailing the results from bench-scale high-rate disinfection studies conducted on City of Syracuse CSOs that received microscreen treatment. The City of Syracuse CSOs exhibited a great variability in chemical and bacterial composition and, therefore, a comparison of disinfection effectiveness to screened and unscreened CSOs showed little or no predictable effects. It was generally concluded from this study that screening does not enhance the disinfection of CSOs.

A full-scale CSO screening facility in the City of Atlanta has been operating for several years. This facility consists of coarse mechanical screening followed by rotary drum screens and high-rate disinfection. The facility has a fecal coliform discharge limit of no greater than 1,000 colonies/100 milliliters (ml) - less stringent than the County's treatment requirement of 200 colonies/100 ml - with influent fecal coliform concentrations ranging from 40 colonies/100 ml to 110,000 colonies/100 ml. In addition, influent TSS concentrations average 300 milligrams per liter (mg/l). According to the facility operations personnel, adequate disinfection has been difficult to achieve since the screens do not remove any appreciable TSS due to the variability in influent TSS and fecal coliform concentrations.

Since screening technology typically used in CSO applications does not remove appreciable levels of TSS, bacterial reduction following screening treatment alone is extremely difficult to achieve due to the TSS interference with the disinfection process. For this reason, screening immediately followed by high-rate disinfection is not considered feasible to meet the County's ACJ requirements for bacterial reduction. Screening technologies do, however, provide effective floatables control and may be used in conjunction with other treatment technologies and high-rate disinfection to satisfy ACJ requirements.

Vortex Separators:

There are presently three different vortex separator design configurations: the EPA swirl concentrator, the Fluidsep® vortex separator and the Storm King® hydrodynamic separator. A summary listing of vortex separator installations for CSO treatments in the United States has been included as Appendix F.

Although there are a number of vortex separator installations in the US for CSO treatment, there is limited performance data for the Fluidsep vortex separator and Storm King hydrodynamic separator. Because the EPA swirl concentrator was the subject of numerous research and performance studies as part of the agency's Research and Development Program in the mid- to late 1970s and early 1980s, significant performance data are available for the swirl concentrators. These data demonstrate the EPA swirl concentrator to be an effective preliminary treatment device prior to the high-rate disinfection of CSOs (Syracuse, NY, USEPA, 1979; Rochester, NY, USEPA 1979).

Due to the established ability of vortex separators, and in particular the EPA swirl concentrator, to provide effective preliminary treatment for high-rate disinfection, vortex separators remain a viable technology for compliance with the County's ACJ CSO treatment requirements.

Continuous Deflective Separation (CDS):

The CDS technology was developed to treat stormwater for the removal of litter and coarse sediments. At the present time, there are only two installations (Louisville and Jefferson County (KY) Municipal Sewer District, installed January 2000) that are being used to treat CSOs. Initial performance results for these installations indicate that removal of debris after a storm event is unwieldy and cumbersome. The CDS technology has demonstrated some ability to remove TSS and BOD. However, there is no further supporting documentation for CSO treatment using the CDS technology. Due to limited operating experience of CDS for treating CSOs, this technology, combined with high-rate disinfection, is not considered feasible to meet the County's ACJ requirements for CSO treatment.

Overflow Retention Facility (ORF).

An overflow retention facility (ORF) is equivalent to a primary sedimentation tank, with the exception that an ORF operates intermittently and, therefore, does not require automatic solids removal. A listing of ORF installations for CSO treatment is included in Appendix G. ORFs are sized based on surface overflow rates, which are a measure of the flow rate per unit area. ORFs, therefore, typically use significantly more surface area and volume than other CSO treatment technologies. The ORF, however, offers an added advantage in that it provides retention of all or a significant portion of the CSO volume associated with storms smaller in size than the design storm event.

Because the ORF essentially operates as a high-rate primary sedimentation process, pollutant removal efficiencies are generally expected to be at the low end of typical primary sedimentation removal efficiencies for domestic sewage (i.e., 50% TSS removal, 35% BOD removal, and 80% settleable solids removal). Baffles are also used in the ORF to dissipate the energy of influent flows, reduce short-circuiting, and trap floatables. Due to the fact that an ORF provides sufficient preliminary treatment prior to disinfection, this technology remains a viable technology for compliance with the County's ACJ treatment requirements.

Alternative Approaches

Regional Conveyance and Storage

Although facility performance will be highly dependent upon the treatment technology utilized for the regional treatment facility, considerable capital as well as O&M cost advantages may be attained through consolidation of facilities at a single site. Regionalization also provides more flexibility in siting facilities, because conveyance systems may be designed to divert multiple overflows to more readily accessible or available properties. Larger facilities may be cost effectively designed to provide for greater flexibility and better performance while operating under highly variable flow conditions inherent to combined sewer overflows. This approach provides a viable alternative to installing individual treatment facilities for each overflow point.

Centralized Storage/Treatment at Metro:

As discussed in Section 3.2.1, centralized storage and treatment of CSOs at Metro provides the highest degree of pollutant removal for CSOs due to the level of treatment received at the Metro plant. This technology, therefore, remains viable for compliance with the County's ACJ CSO treatment requirements, contingent upon the feasibility of CSO conveyance to METRO. This is currently being considered under the facility plan being conducted for the Harbor Brook basin.

As a note, it should be pointed out that at the completion of the existing CSO abatement program approximately 90% of the total average of wet-weather flow in the combined sewer system will be either eliminated through sewer separation or transported to and treated at Metro.

Sewer Separation.

Because sewer separation essentially eliminates or removes a CSO discharge(s) in the service area being separated, this technology remains a viable technology for compliance with the County's ACJ CSO treatment requirements. Application of this approach is limited to those CSO basins which are able to be separated cost effectively compared to other alternatives.

3.3 Conclusions

Based upon the preliminary and secondary screening of CSO treatment technologies/approaches described in Sections 3.2.2 and 3.2.3 above, the following technologies/approaches are determined to be the <u>most</u> feasible for the treatment of CSOs tributary to Metro for compliance with ACJ requirements:

A. Vortex separators with high-rate disinfection
B. Overflow retention facility (ORF) with high-rate disinfection
C. Regional Conveyance and Treatment
D. Centralized storage/treatment at Metro and Harbor Brook
E. Sewer separation
F. Regional storage in limited cases

4.0 Program Enhancement Options

4.1 Enhancement Option Development

As noted in Section 1, a number of CSO evaluation workshops were held to identify opportunities to improve the existing CSO abatement program. Brainstorming sessions were held during the first two workshops, in which the workshop participants were asked to identify options to the existing CSO Program. During this workshop a long comprehensive list was developed without regard to cost or applicability to specific requirements. During the second workshop, the comprehensive list was evaluated, resulting in a shortlist of options that have potential for implementation in Onondaga County. Evaluation criteria for developing the shortlist included:

- Ability to meet program requirements
- Community impacts
- Ability to achieve environmental requirements
- Ability to meet ACJ schedule
- Conceptual cost

The shortlist of options considered worthy of more detailed analysis is as follows:

A. Additional Treatment at Metro using tertiary clarifiers to treat increased flows from:

- Kirkpatrick Street Pump Station
- Harbor Brook Drainage Basin

B. Optimization of Midland Avenue and Clinton Street Regional Treatment Facilities (RTFs)

C. Construction of Storage Facility at Schiller Park on the Butternut Trunk Sewer

D. Optimization of EBSS Capacity by separating storm water component

E. Optimization of Hiawatha Boulevard RTF

F. Raise the side wall elevation of the Spencer Street Bypass Structure

4.2 Description of Potentially Feasible Options

This section describes details of the options that were identified and evaluated to improve the ACJ CSO Program. Additional, more detailed information can be found on each of these options in the appendices.

4.2.1 Option 1 – Use of Tertiary Tanks at Metro for Storage and/or Treatment of CSOs

- Kirkpatrick Street Pumping Station

- Harbor Brook Combined Sewer Service Area

The tertiary clarifiers at Metro will become available for other uses after the new ammonia/ phosphorus facilities are completed. These clarifiers will not be needed for normal dry-weather treatment and will be removed from the process train. The tertiary clarifiers were originally constructed as primary treatment units. There are six circular clarifiers, 112 feet each in diameter and 10 feet (side water) deep.

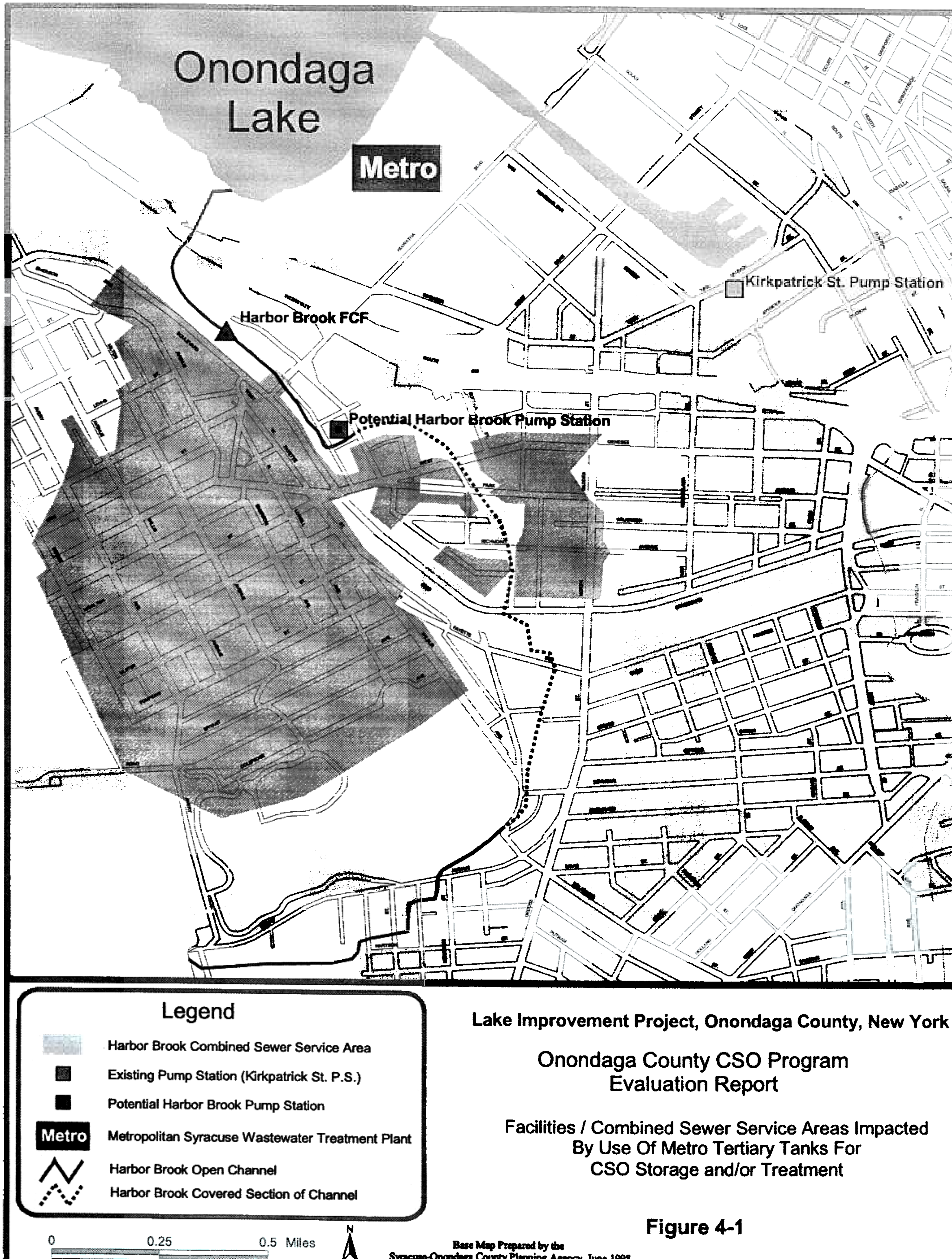
A preliminary evaluation of these clarifiers for CSO treatment has been conducted which indicates that it may be feasible to convert the units to storage or primary settling basins to treat flow rates up to 120 mgd (at 2000 gpd/ft^2), and to provide storage (overflow retention) for approximately 5 million gallons. Consideration for disinfection in the clarifiers could reduce the peak flow rate and storage volume depending on flow routing scenarios. The clarifiers are in fair condition and will require repairs and/or replacement of internal components as well as some structural repairs. (New piping would be required to transport CSO flows from the KSPS, and/or to convey Harbor Brook CSOs 003, 004 and other lower Harbor Brook basin CSOs. New piping would also be required for discharge of treated flow to outfall 002, and/or stored combined sewage to the plant headworks.) Appendix E contains memoranda that list the identified repairs required to maintain operations of these clarifiers as currently utilized. A more detailed analysis will be conducted as part of the Harbor Brook CSO Facilities Plan to identify all repairs and/or modifications required to convert the units to CSO storage and/or treatment tanks.

Based on a preliminary analysis, the use of tertiary clarifiers for CSO storage and/or treatment is a feasible option. Figure 4-1 illustrates the location of the Kirkpatrick Street Pump Station, the potential Harbor Brook Pump Station, and the affected combined sewer service area within the Harbor Brook drainage basis in relation to Metro.

4.2.2 Option 2 – Combining Midland Avenue and Clinton Street RTFs

A potential alternative to the current ACJ-mandated CSO abatement program for the Midland and Clinton CSO service areas would be to combine the two facilities at the Clinton Street site. This option would include the conveyance of all CSO flows scheduled to be delivered to the Midland Avenue RTF to the Clinton Street RTF. While this option was previously considered during the Midland Avenue project development, it was decided to reconsider the potential feasibility and cost savings by constructing one larger combined RTF rather than two smaller sized RTFs. Because the Clinton CSO service area is downstream of the Midland CSO service area and gravity conveyance is more cost effective, and reliable than pumped conveyances the most cost effective location for a combined RTF would be at the Clinton CSO service area. For the purposes of this exercise, the assumed location of the combined RTF was the Clinton Station site. A facilities planning effort is currently underway and will be the vehicle for final selection of sites for the Clinton CSO Abatement project.

The combined Midland/Clinton RTF would include the CSO conveyances associated with the Midland RTF project, as previously identified in the Midland Avenue Regional Treatment Facility and Conveyances Facilities Plan, dated February 1999. These conveyances would transport the Midland CSO service area flows to a point on the east side of Onondaga Creek



Lake Improvement Project, Onondaga County, New York

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Evaluation Report

Facilities / Combined Sewer Service Areas Impacted
By Use Of Metro Tertiary Tanks For
CSO Storage and/or Treatment

Figure 4-1

between Oxford Street and Blaine Street. Additional conveyances would be required to transport the Midland CSO service area flows from this point to the combined Midland/Clinton RTF site. Clinton CSO service area flows would also require separate conveyances to transport these flows to the combined Midland/Clinton RTF site.

The additional conveyances required to transport the Midland CSO service area flows to the combined Midland/Clinton RTF site would generally proceed along the following route using open-cut trench pipeline installation methods.

- from the current Midland RTF site at Oxford and Blaine Streets the pipe would run between the east bank of Onondaga Creek and the Central New York Regional Transportation Authority (CNYRTA), Centro Bus Garage across Tallman Street, and along South Clinton Street to the proposed combined Midland/Clinton RTF site at Clinton Station (Trolley Lot).

Alternatively, a tunneled conveyance could be constructed from the Oxford Street/Blaine Street location to the combined Midland/Clinton RTF site using a more direct and shorter route.

If the Midland RTF and Clinton RTF were to be constructed separately, the peak flow rate capacities of the RTFs would be as follows:

CSO Regional Treatment Facility	Peak Flow Rate
Midland RTF	667 cfs(1)
Clinton RTF	820 cfs
Separate RTF Subtotal	1487 cfs

Note:

(1) Assumes closure of 6 of 9 CSOs tributary to the Midland RTF

However, if the service areas for Midland and Clinton were combined, the resultant Midland/Clinton RTF would require an estimated peak flow rate capacity of approximately 1,120 cfs. This rate is less than that for separate facilities because of the storage-equalization within the connecting pipeline from Oxford Street to Clinton Street.

To preliminarily assess the feasibility of a combined Midland/Clinton RTF, preliminary conceptual construction costs were prepared for the separate Midland RTF and Clinton RTF, and the combined Midland/Clinton RTF, including associated conveyances. A summary of these preliminary conceptual construction costs is presented below:

Midland RTF Project (Separate)	Estimated Construction Cost(1)
Conveyances	$24.0 million
	$17.0 million
	$41.0 million

Clinton RTF Project (Separate)	Estimated Construction Cost[1]
Conveyances	$11.0 million
RTF	$20.0 million
	$31.0 million

Combined Midland/Clinton RTF	Estimated Construction Cost[1]
Conveyances	$56.0 million[2]
	$27.0 million
Total	$83.0 million

Note:

(1) Does not include engineering, legal, administrative, contingencies land acquisition, easements, mitigation, enhancement and financing costs

(2) Conveyances cost includes open-cut trench pipeline installation. Tunnel conveyances are estimated to be approximately $1.1 million greater than open-cut conveyances installation.

Based upon a comparison of the preliminary conceptual construction costs for the separate Midland RTF and Clinton RTF ($41.0 million + $31.0 million = $72.0 million) and the combined Midland/Clinton RTF ($83.0 million), the separate, smaller Midland and Clinton RTFs would be significantly less expensive to construct than the single combined Midland/Clinton RTF.

This is primarily due to the excessive additional conveyance costs required to transport the Midland CSO service area flows to the combined Midland/Clinton RTF site. In addition to these cost impacts, there would be significant constructability issues and construction impacts to downtown Syracuse residents and businesses that would be associated with constructing the additional conveyance from the Midland CSO service area to the Clinton CSO service area. A combined RTF at Clinton would be 37% larger than the separate RTF, resulting in an increased impact in the Clinton area. For these reasons, a combined Midland/Clinton RTF is not considered to be a viable alternative for CSO abatement for the Midland Avenue and Clinton Street CSO service areas.

4.2.3 Option 3 – Construction of Storage or Overflow Retention Facilities (ORF's) at Schiller Park

The Schiller Park CSO Storage Option would involve the construction of an underground tank at Schiller Park on the Butternut Trunk Sewer that would provide temporary storage of excess combined sewer system flows. The storage tank would accept flow from two new combined relief sewers in addition to the Butternut Trunk Sewer, as shown on Figure 4-2.

The storage system would allow control of a significant portion of the combined and separately sewered acreage on the north side of the City of Syracuse. The project would directly affect the discharge of 579 acres of combined and sanitary sewer above the proposed Schiller Park facility, in addition to 261 acres that are tributary to the Butternut Trunk Sewer at Teall Avenue (CSO 073). The potentially impacted areas are demonstrated on Figure 4-3. The option would indirectly affect the wet-weather flow from 330 acres downstream of the facility by allowing more of that flow to enter the Main Interceptor Sewer (MIS).

Two conditions exist to suggest that additional storage in the Butternut Combined Trunk Sewer system would benefit the CSO program and/or provide relief to north side residents that suffer from periodic flooding.

First, the Butternut Trunk Sewer drains an area of 850 acres. Dry weather flow discharges to the main interceptor sewer underneath I-690 near Mission Landing. The County constructed two floatables control facilities FCFs) at Franklin Street that treat combined flows from the Butternut system and the Burnet system (CSO 020 and CSO 021). The 8 bag Butternut FCF netting facility receives a significant flow generated by the Butternut drainage area resulting in substantial maintenance being required for the Butternut FCF.

Second, because many of the original sewers installed on the north side of Syracuse were undersized for wet weather flow conditions, a number of neighborhoods experience regular problems with basement and/or street flooding when storms exceed approximately .07 inch per hour intensities. A storage or ORF facility in the vicinity of Schiller Park could help to reduce periodic flooding conditions in these areas.

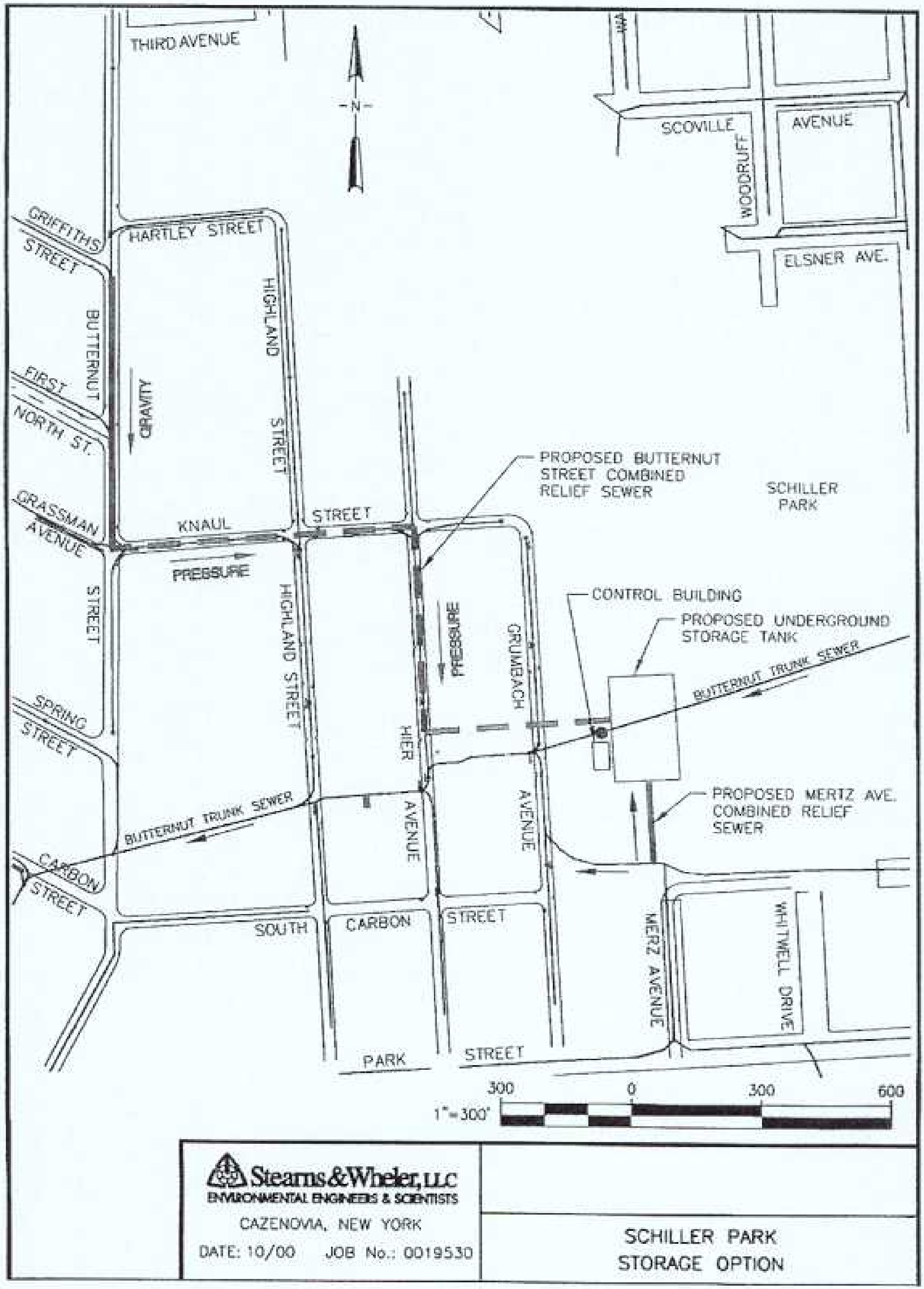
Preliminary cost estimates have been developed for this option. A storage facility sized to provide flooding relief to the Highland area would cost approximately $11.4 million to accommodate the 5-year design storm. If the 10-year design storm is used, the cost would be $12.7 million.

This option would require the construction of the following elements:

A. Underground Concrete Storage Tank in Schiller Park (probably requiring an alienation of park land procedure) and reconstruction of the ballfields located at the site.

B. Combined Relief Sewer from Knaul and Butternut Streets.

C. Combined Relief Sewer from the Whitwell Drive and Mertz Avenue Area.



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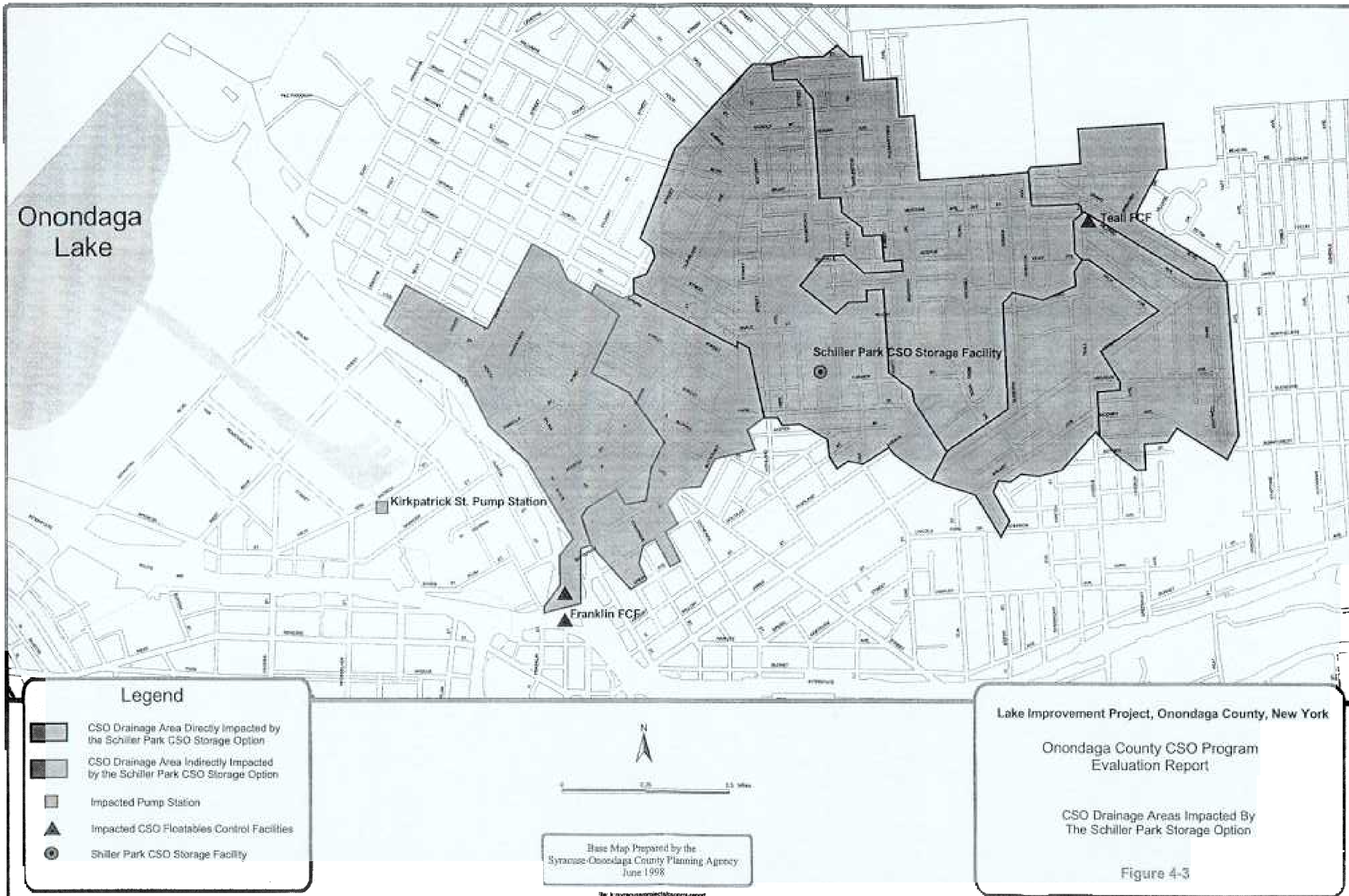
Evaluation Report

Schiller Park Storage Option

Figure 4-2



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Onondaga County CSO Program
Evaluation Report

CSO Drainage Areas Impacted By
The Schiller Park Storage Option

Figure 4-3

D. Real Time Control System.

Each of these elements is discussed in detail in Appendix I.

The storage facility could be operated as either an on-line or off-line facility using a series of sluice gates. For normal events, the facility would be operated as an on-line facility and would trap the flow of the Butternut Trunk Sewer in addition to the two combined relief sewers. When exceptionally heavy rains are expected, the facility could be operated in an off-line mode, with the storage capacity being reserved to reduce flooding in the Highland area.

The lower athletic fields would be unusable for approximately two years during construction. A small aboveground building would need to be constructed on the side of the park near Grumbach Avenue. This building would house controls and odor control equipment. The cost of reconstruction of the athletic fields would be included in the total cost of the storage project.

The Schiller Park storage option would control the flow of the Butternut Trunk Sewer and the amount of combined sewage being discharged from CSO 020. Currently, wet-weather flow from the Butternut Trunk Sewer receives treatment to remove floatables prior to being discharged. The Schiller Park storage option will significantly reduce the frequency and magnitude of events being treated at the Franklin FCF.

One of the most significant benefits of this option would be the reduction in the annual CSO discharge volume. Simulations performed by Moffa & Associates indicate that the Schiller Park storage option would reduce the annual volume discharged at CSO 020 from 81.5 million gallons to 7.7 million gallons.

It is recommended that the Schiller Park Storage option be further evaluated to confirm the benefits, impacts, feasibility and costs. Specific recommendations include:

A. Installation of flow meters at key locations for model calibration and validation.

B. Assessment of impacts of the Schiller Park storage option using the calibrated model. This would include demonstrating the impact of the option on reduced flooding in the local combined sewer system, operation of the Franklin FCF, and reduction in overflow frequency and volume at the Spencer St. Bypass. On-line and off-line simulations would be conducted for storage tanks of different sizes. The analysis should also include the continuous simulation for the "average year" of 1991 to confirm the annual CSO volume reduction benefits.

C. Refining of flow interception schemes for the two combined relief sewers.

D. Preliminary subsurface exploration program.

E. Preliminary design layouts.

F. Preparation of cost estimates.

4.2.4 Option 4 – Optimization of EBSS Capacity

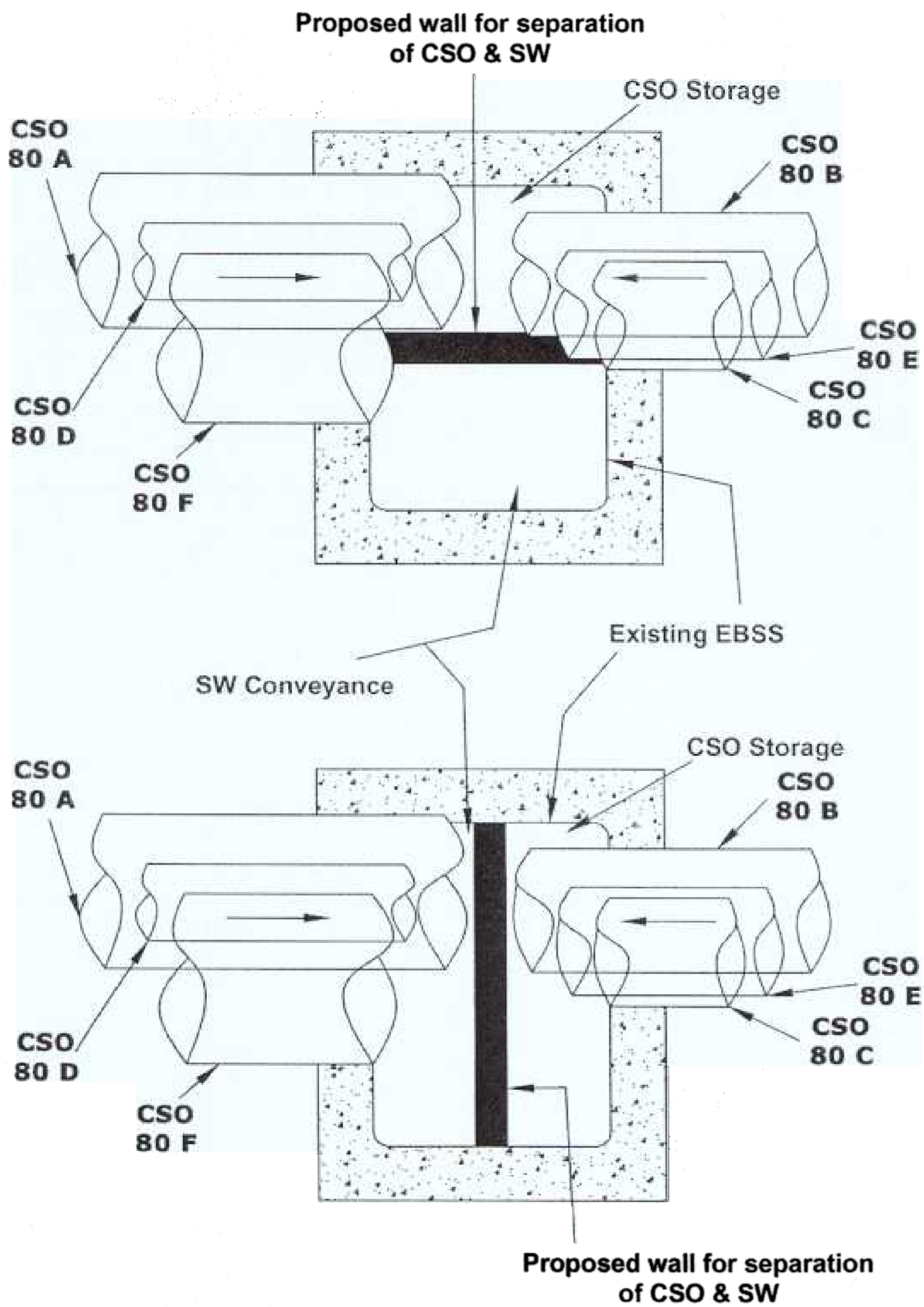
The Erie Boulevard Storage System (EBSS) is a large-diameter storm sewer running underneath Erie Boulevard from Teall Avenue to Onondaga Creek with sufficient capacity to store combined sewer overflows and stormwater that results from a 90th percentile storm over its tributary area. The 90th percentile storm is a storm that is derived from local rainfall data, whose total rainfall is not exceeded more than 10 percent of the time during an average year. The EBSS is approximately 7.5 feet by 10.5 feet with a total volume of approximately 5 million gallons. Additionally, there are approximately 1 million gallons of storage associated with the ancillary conveyance pipe connected to the EBSS.

The EBSS Facility has experienced operational problems from the time it was completed in 1985 and is currently not functioning in accordance with the original design. The EBSS has automated sluice gates that were designed to entrap CSOs (and stormwater) that would otherwise discharge to Onondaga Creek. Stormwater and CSOs were to be temporarily stored in the EBSS until Metro had the capacity to accept the flow. This would have been accomplished through the use of the automatic control gates and an integrated monitoring system.

The Stormwater Management Model (SWMM) was used to evaluate the EBSS. This most recent evaluation identified the benefits of re-activation of the EBSS including the capture of overflow for different design storms. The evaluation also identified that during the design event (90% storm), the EBSS is dominated by stormwater from the upper most reaches (eastern most part) of the EBSS tributary area. Approximately 70% of the combined sewage in the EBSS during the design event is from separate storm sewers. In light of this discovery, additional analyses were performed to investigate potential modifications to the storm sewer to isolate this component of stormwater from the CSO within the EBSS.

Consideration was given to modifying the existing EBSS conduit to allow the stormwater component to be conveyed directly (separately) to Onondaga Creek, and at the same time capture and store the CSO component. The purpose of this would be to isolate the stormwater from the CSO and discharge the stormwater separately from the CSO flow. In order to accomplish this, the EBSS would need to be sectioned approximately in half, either horizontally or vertically. An initial investigation of the horizontal sectioning indicated that this was impractical due to the relative elevations of the interconnecting sewers to the EBSS. Overflows connecting to the EBSS enter at different elevations and would not be able to be connected to the horizontal sectioning in the top portion of the conduit. Similarly, if the conduit were sectioned vertically, the conduit would not be able to accommodate the pipes entering from both sides of the EBSS without compromising the flow through capacity of the conduit. Figure 4-4 depicts the interconnecting sewers to the EBSS that would need to be considered if such an alternative were to be implemented.

A complete description of this evaluation is included in Appendix J.



MOFFA & ASSOCIATES
CONSULTING ENGINEERS
SYRACUSE, NEW YORK

Schematic of
EBSS Storm Water
Alternatives

DATE: 9/21/2000

Figure
4-4

4.2.5 Option 5 – Optimization of Hiawatha Blvd. RTF

The problem identified in this case was the need to modulate flows from the Kirkpatrick Street Pump Station to reduce the potential for developing by-pass conditions at Metro. While such conditions infrequently occur and typically would require all Metro influent sources to peak simultaneous, the intent is to maximize treatment of CSO by Metro. During the planning and design of the Kirkpatrick Street Pump Station Upgrade project, it was determined that there were several methods that might be utilized to achieve the goal of maximizing CSO treatment and minimizing the occurrences of by-pass events at Metro.

Optimization of the Hiawatha RTF can help manage flows in the Hiawatha trunk sewer. This would be accomplished by retaining more of the wet-weather flow in the upper trunk sewer and diverting it to the Hiawatha RTF for treatment and discharge or for temporary storage with subsequent treatment at Metro.

Specific measures for control of excess flows could include:

A. Installation of a fixed orifice on the Hiawatha trunk sewer in the vicinity of Lodi St.

B. Modification of the overflow manhole at CSO 074 at Spring Street to direct more flow to the RTF.

C. Modification of the orifice plates located at the new overflow control structures on North Salina, Carbon, and Spring Streets.

The appropriateness of these measures and the details of their implementation will be evaluated after start-up and testing of the Hiawatha RTF.

Impact of Carousel Mall Expansion

The expansion of the Carousel Mall will require relocation of the Hiawatha trunk sewer and elimination of CSO 075. If the mall expansion project goes ahead, the issue of wet-weather flow management becomes more complex. Should elimination of CSO 075 occur, it will be necessary to provide an alternate relief point for excess system flows. An alternative approach to providing additional relief is to provide in-line storage for anticipated wet-weather flows within the replacement trunk sewer itself. This storage could accommodate the overflow volumes which would have discharged at CSO 075, attenuate flows to the Kirkpatrick Street Pump Station (KSPS), and help manage wet-weather flows delivered to Metro.

A preliminary analysis of storage options has been performed as part of the KSPS basis of design. Further analysis as to what diameter trunk sewer would provide appropriate storage should be completed in order that the appropriate balance between required CSO transmission and CSO storage/treatment capacity can be determined

Following start-up and testing of the Hiawatha RTF, an evaluation of treatment capacity and effectiveness can be made. Based on this evaluation, appropriate alternatives to optimize the capacity of the RTF can be developed further. This will require some additional modeling to ascertain the quantity of flow and degreee of surcharging that can be accommodated by the sewers tributary to the Hiawatha RTF. Implementation of these alternatives should be coordinated with the construction of the KSPS improvements and take into account the progrss of the planned mall expansion.

4.2.6 Option 6- Spencer Street Bypass Closure

An evaluation was performed to assess potential options to address this discharge. The frequency and magnitude of the discharge was unknown during the development of the most recent Facilities Plan (Moffa, 1991) and the Municipal Compliance Plan 1996. Specific evaluations were performed during the design of the Kirkpatrick Street Pump Station Upgrade project. It was determined that the flow at this location could largely be controlled by raising the existing weir structure by 15 inches to reduce the frequency of overflow in the approximate one year storm. These improvements will be completed and monitored. If they are found to be insufficient, alternative overflow control measures will be considered.

The construction of the Schiller Park storage alternative and other regional treatment facilities and CSO interceptor sewers could also reduce the frequency and magnitude of discharge at this location. A detailed evaluation of these measures has not yet been performed. Appendix D provides details of potential abatement alternatives.

4.3 Conclusions

The program options described in Section 4 could improve the County's CSO program by addressing a number of aspects and issues that were not known during the time the ACJ program was formulated. Subsequent evaluations have been formed for a number of the options. However, additional work will be required before other recommendations can be made.

4.3.1 CSO Volume Capture

As indicated previously, the ACJ requires elimination or capture for treatment of at least 85% of the total average annual wet weather flow in the combined sewer system. The identified CSO Program options could increase the amount of wet-weather flow that is captured for subsequent treatment at Metro. The current "Percent-Capture" (for treatment at Metro) from the combined sewer system is 75% without the abatement facilities required under the ACJ. This number would rise to 90% (including elimination and capture for treatment at Metro) with construction of the ACJ CSO projects.

The following table indicates the anticipated additional volume capture statistics with the optional CSO program elements previously described. The percentages have been based on the total annual wet-weather flow of 4,219 MGY as developed in Table 2-4.

Option Description	Additional Volume Capture (MGY)	Additional Percent Capture
Additional Treatment at Metro [1]	To Be Determined	To Be Determined
Schiller Park Storage	73.8	1.75
Spencer Street Bypass Modifications	1.2	0.03
Harbor Brook Facilities[2]	To Be Determined	To Be Determined

1 Additional capture from Kirkpatrick Street PS flows and lower Harbor Brook drainage basin
2 Additional capture from upper Harbor Brook basin

4.3.2 Water Quality Impacts

There were two principal water quality impacts associated with CSO discharges in Onondaga Lake, namely floatables and bacteria. The ACJ program was structured to address both of these impacts. Several of the optional CSO program elements, if implemented would provide additional water quality benefits by virtue of the additional volumetric capture and treatment of CSO.

Floatables Control

Floatables control would be beneficially impacted by implementation of options 1,3,4,5 and 6.

Bacteria

The ACJ program was designed to achieve bacterial compliance for all of the Class B waters of Onondaga Lake. A model was created and used to project bacterial concentrations for eight different segments of the lake. This tool, as described in Appendix B, was used to project bacteria concentrations that existed in the lake prior to any CSO abatement project implementation and the improvements that were expected as ACJ facilitates were brought on line. It was demonstrated that bacterial violations would cease to occur for all but the southern most cell of the lake. This cell takes the discharge from all tributaries with CSO sources (Onondaga and Ley Creeks and Harbor Brook). It was projected that in the average year (1991) that there would be seven instances where the bacterial concentrations would exceed 200 cells/100ml. This is a conservative representation since the actual standard calls for the average of five measurements, not just a single value exceeding the threshold limit.

The bacterial model will continue to be used to evaluate the impact of the optional CSO abatement projects previously discussed. The most significant consideration was the determination of alternate CSO abatement facilities for the Harbor Brook basin.

Summary of Conclusions and Recommendations

5.1 CSO Program Analysis Conclusions:

The latest analysis of the currently proposed CSO Abatement Plan projects 90% elimination or capture for treatment at the Metro plant. These projected capture rates exceed the Federal and State CSO policies and guidance, as well as the ACJ requirement of 85% capture of the total average annual wet weather flow.

CSO Program Recommendations:

The CSO Program should be periodically reviewed and updated as changes in the CSO Abatement Plan evolve.

Metro Capacity Analysis Conclusions:

The Spencer Street Bypass is active approximately 9 times per year. The principal cause of its activation is the limited capacity (120-mgd) of the downstream twin barrel siphon crossing of Onondaga Creek.

The best location to tie in the proposed KSPS force main at Metro is on the upstream side of the existing Screenings and Grit Building.

The actual frequency of wet-weather bypasses at Metro is estimated to be once every five or six years. The SWMM Model indicates that the proposed KSPS upgrade will have little impact on the frequency or magnitude of bypasses.

Metro Capacity Analysis Recommendations:

The County will raise the overflow weir at the Spencer Street Bypass by 15 inches and monitor the frequency of overflow and impacts to upstream hydraulic conditions. If these measures do not sufficiently reduce the frequency of overflow, additional engineering analyses should be performed to determine the feasibility and cost associated with modifying the tertiary tanks at Metro for storage and/or treatment of additional flow associated with the KSPS upgrade and the Hiawatha Boulevard Combined Trunk Sewer.

SWMM Model Technical Review Conclusions:

The SWMM model used to analyze the CSO system is generally sound and accurately reflects the current and projected conditions resulting from the proposed CSO abatement plan.

SWMM Model Technical Review Recommendations:

The model should be expanded to include the Spencer Street Bypass, Lower Crossing siphon and connection of the Harbor Brook collection systems, as well as all separate sanitary systems tributary to the MIS and Harbor Brook sewer service area. Upon completion of the expansion of the model, the results should be compared with measured CSO data and system flows. Additional modifications to the model should be performed as facilities are completed and become operational to ensure the model accurately reflects the system as the project evolves.

The history and development of the hydraulic and hydrologic models as well as the details and assumptions behind the model setup, development, applications and results should be documented. This background data should be updated as the model is expanded to include recently completed facilities.

Additional rain gage installations should be considered to support future model analyses, calibration, and facility operations.

Bacteria Model Conclusions:

The Onondaga Lake Bacteria Model demonstrates compliance with the ACJ bacteria concentrations for the "Class B" sections of the lake.

5.8 Bacteria Model Recommendations:

The USEPA Draft CSO Guidance, released on December 20, 2000, should be reviewed in detail to determine the level of additional sampling, modeling and monitoring that may be necessary to document and evaluate the water quality improvements associated with the implementation of the CSO Abatement Program.

5.9 Evaluation of Treatment Technologies and Approaches-Conclusions:

The most feasible treatment technologies/approaches for compliance with the ACJ requirements are as follows:

- Vortex separators with high-rate disinfection
- Overflow retention facilities with high-rate disinfection
- Regional conveyance and treatment
- Centralized storage/treatment at Metro and Harbor Brook
- Sewer separation
- Regional storage

5.10 Evaluation of Treatment Technologies and Approaches – Recommendations:

No further recommendations at this time.

5.11 Program Enhancement Options – Conclusions:

- Option 1 - The tertiary clarifiers at Metro may be utilized to store and/or treat additional wet weather flow providing further enhancements to the CSO Abatement Program.

  Option 2 - Preliminary analysis indicates that combining the Midland and Clinton RTF's into one large RTF is more costly and disruptive than installing separate facilities.

- Option 3 – Construction of a storage or overflow retention facility at Schiller Park may provide performance benefits to the CSO program as well as reduce flooding in nearby neighborhoods.

- Option 4 – Separation of the sewer service area tributary to the Erie Boulevard Storage System by partitioning the interceptor sewer is not feasible.

  Option 5 – Optimization of the Hiawatha RTF and the provision of additional storage capacity in the replacement trunk sewer, as necessitated by the closure of Outfall 075 under the Carousel expansion plans, may help to reduce bypasses at Metro by attenuating flows to the Kirkpatrick Street Pumping Station.

- Option 6 – Raising the side wall elevation at the Spencer Street Bypass structure will reduce overflows. Additional monitoring and modeling, to quantify that reduction, will be necessary.

5.12 Program Enhancement Options – Recommendations:

- Option 1 - Further assessment of the use of the tertiary clarifiers at Metro for storage and/or treatment should be performed upon development of the CSO Facilities Plan for the Harbor Brook Drainage Basin.

- Option 2 – Separate treatment facilities should be provided for the Midland and Clinton overflow points.

- Option 3 – An evaluation should be performed to further evaluate the benefits, impacts, feasibility and costs associated with the Schiller Park Storage or overflow retention facility option.

- Option 4 – The County should forego any further analysis of separating the sewer service area tributary to the Erie Boulevard Storage System and should continue with the design of the new control vaults and collection system improvements.

- Option 5 – Upon start-up and operational testing of the Hiawatha RTF and consideration of the status of the proposed Carousel expansion project, additional engineering analysis should be performed to evaluate the potential to modulate flows to Metro and maximize treatment of CSO's.

- Option 6 – Should raising the side wall elevation of the Spencer Street Bypass by 15 inches provide an insufficient reduction in the frequency of overflows at this site further SWMM modeling should be performed to assess the feasibility of raising the weir or completely closing the outfall. The model should take into consideration the impacts of the Schiller Park Storage Facility (Option 3) and the storage and pump back volumes generated by the Midland and Clinton RTF's.

APPENDIX A

EXCERPT FROM FEDERAL REGISTER/VOL.59
NO.75/TUESDAY, APRIL 19, 1994. PAGE 10

Appendix A

Excerpt from Federal Register/Vol. 59, No. 75/Tuesday, April 19, 1994

A. "Presumption" Approach

A program that meets any of the criteria listed below would be presumed to provide and adequate level of control to meet the water quality-based requirements of the CWA, provided the permitting authority determines that such presumption is reasonable in light of the data and analysis conducted in the characterization, monitoring, and modeling of the system and the consideration of sensitive areas above. These criteria are provided because data and modeling of wet-weather events often do not give a clear picture of the level of CSO controls necessary to protect WQS.

No more than an average of four overflow events per year, provided that the permitting authority may allow up to two additional overflow events per year. For the purpose of this criterion, an overflow event is one or more overflows from a CSS as the result of a precipitation event that does not receive the minimum treatment specified below; or

ii. The elimination or the capture for treatment of no less than 85% by volume of the combined sewage collected in the CSS during precipitation events on a system-wide annual average basis; or

iii. The elimination or removal of no less than the mass of the pollutants, identified as causing water quality impairment through the sewer system characterization, monitoring, and modeling effort, for the volumes that would be eliminated or captured for treatment under paragraph ii. above. Combined sewer flows remaining after implementation of the nine minimum controls and within the criteria specified at II.C.4 or ii, should receive a minimum of:

- Primary clarification (Removal of floatables and settable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification.);
- Solids and floatables disposal; and
- Disinfection of effluent, if necessary, to meet WQS, protect designated uses and protect human health, including removal of harmful disinfection chemical residual, where necessary.

B. "Demonstration" Approach

A permittee may demonstrate that a selected control program, though not meeting the criteria specified in II.C.4.a above is adequate to meet the water quality-based requirements of the CWA. To be a successful demonstration, the permittee should demonstrate each of the following:

i. The planned control program is adequate to meet WQS and protect designated uses, unless WQS or uses cannot be met as a result of natural background conditions or pollution sources other than CSOs;

ii The CSO discharges remaining after implementation of the planned control program will not preclude the attainment of WQS or the receiving waters' designated uses or contribute to their impairment. Where WQS and designated uses are not met in part because of natural background conditions or pollution sources other than CSOs, a total maximum daily load, including a wasteload allocation and a load allocation, or other means should be used to apportion pollutant loads;

iii The planned control program will provide the maximum pollution reduction benefits reasonably attainable; and

iv. The planned control program is designed to allow cost effective expansion or cost effective retrofitting if additional controls are subsequently determined to be necessary to meet WQS or designated uses.

APPENDIX B

MEMORANDUM-BACTERIAL PROJECTIONS

MEMORANDUM

To:	Robert J. Kukenberger	**Date:**	November 15, 2000
From:	Howard M. Goebel, P.E. Daniel P. Davis, P.E.	**File No.:**	154.01.04I
Re:	Onondaga Lake Bacteria Model	**cc:**	

BACKGROUND

An event-based fecal coliform bacteria model was developed by UFI (1987) to allow the projection of Onondaga Lake bacteria concentrations from wet weather discharges associated with the Syracuse Combined Sewer System. The model was based on detailed tributary loading measurements and Lake responses for a period during the summer and fall of 1987. Two storms were described in detail upon which the model was calibrated and verified.

Although the original event-based bacteria model was reviewed and approved by NYSDEC, it proved to be inadequate as a tool for long-term simulation to assess the impact of different CSO abatement alternatives for Onondaga Lake. Accordingly, a new effort was undertaken to improve the model to be more useable as a predictive tool.

MODEL DEVELOPMENT

Moffa & Associates retained the author of the aforementioned bacteria model to make modifications that would allow the use of the model for continuous simulation to assess the impact of different CSO abatement alternatives. A number of simplifications have been incorporated into the model to allow this intended use including fixed kinetic input data files (chlorophyll and wind), and loadings for minor tributary streams.

Moffa & Associates has run the Annual Simulation Fecal Coliform Model for Onondaga Lake (bacteria model), Version 1 for the year 1991. This year was chosen since it has characteristics of an average year, based on annual rainfall. The revised model allows inputs from the major tributaries into Onondaga Lake. These tributaries include Onondaga Creek, Harbor Brook, Ley Creek, Ninemile Creek, East Flume, Trib. 5a., Bloody Brook, and Sawmill Creek. The inputs are divided into discrete geographical regions within the Lake in order to assess their regional effect on the Lake. The Lake has been subdivided into eleven sub-areas or Cells, as shown in Figure 1. Cells 1 through 8 are surface layers and Cells 9 through 11 are bottom layers. Cell 1 consists of the surface layer at the southern end of the Lake and is of great interest since all of the nine proposed Combined Sewer Overflow (CSO) Abatement Facilities discharge into streams that outlet into Cell 1.

Figure 1: Onondaga Lake Bacteria Sampling Locations and Bacteria Model Cell Configuration

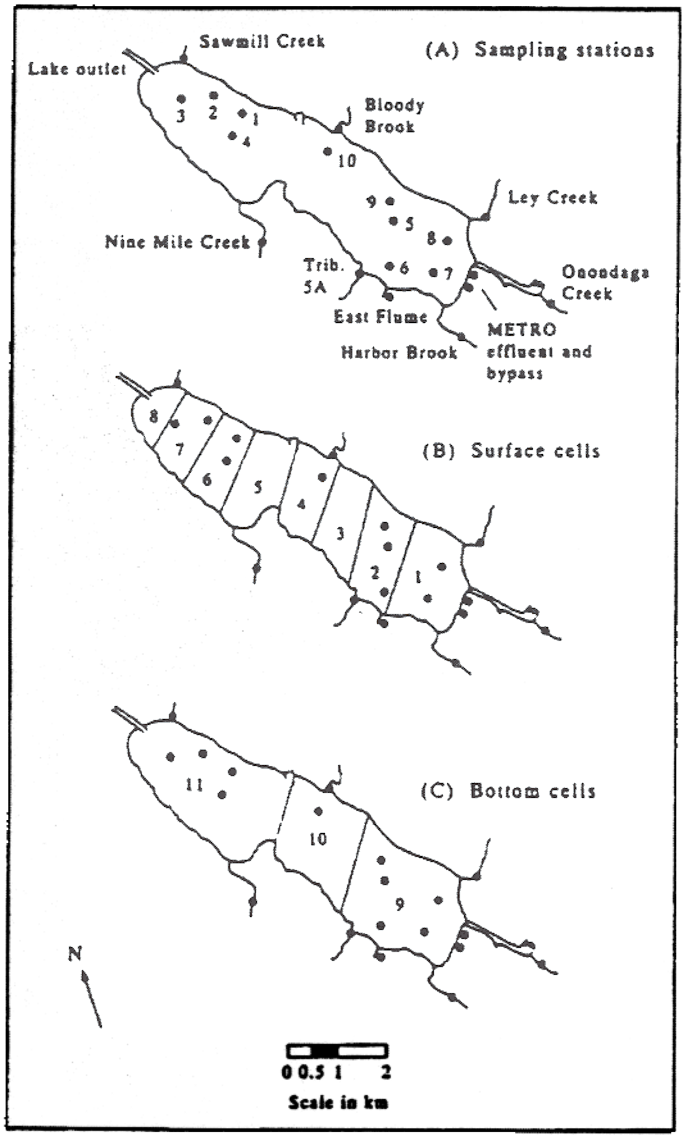


Fig. 1. Onondaga Lake: sampling locations and model cell configuration. (A) Lake and tributary sampling stations, (B) model cell configuration—surface layer and (C) model cell configuration—bottom layer. METRO = the Metropolitan Syracuse Treatment Plant.

(A) Lake and tributary sampling stations, (B) model cell configuration–surface layer, and (C) model cell configuration–bottom layer

Adopted: Canale, et al., 1993

MODEL INPUTS

The data input requirements for the bacteria model include:

average daily streamflow (cubic meters per day)
hourly fecal coliform bacteria loading (colony forming units, cfu per day)
daily wind speed (meters per second)
- daily chlorophyll (micrograms per liter).

For both wind and chlorophyll variables, typical values provided by the model authors experience were used for all model runs.

The average daily flow data for Onondaga Creek, Harbor Brook, Ley Creek and Ninemile Creek were taken from USGS gauging stations for the year 1991. Flow data for the remaining input streams were not available and were not used in this analysis since they are minor contributors to the total flow and load (Canale et al., 1993).

The TRANSPORT block of SWMM was utilized to develop models for each of the proposed CSO abatement facilities. Each model incorporated the existing regulator structures, as well as the proposed transmission pipelines, where appropriate. Long-term continuous simulation projections were developed to estimate the quantities of CSO volumes for 1991.

The SWMM models were run for each CSO abatement facility to generate overflow hydrographs. Hourly CSO flows were developed for these scenarios for the entire year (1991) using rainfall data collected at Hancock International Airport.

Hourly bacteria loads were estimated based on hourly flows developed from the SWMM combined with average concentrations for each individual CSO facility. Average facility-specific bacteria concentrations were estimated based on 1,544 bacteria samples obtained by O'B&G (O'Brien & Gere, 1979) and are summarized in Table 1.

Table Average CSO Fecal Concentrations

CSO Abatement Facility	Avg. Fecal Coliform Densities (CFU/100 ml)
Clinton Station RTF	2.25E+06
Erie Blvd. Storage System	1.20E+05
Franklin St. FCF	1.29E+06
Harbor Brook IWS	1.74E+06
Hiawatha RTF	6.83E+06
Maltbie St. FCF	1.30E+05
Midland Ave. RTF	1.34E+06
Newell St. RTF	4.70E+05
Teall Brook FCF	5.20E+05

The RTFs' will incorporate disinfection facilities sized to provide a minimum 3-log kill (99.9% efficiency of disinfection) at the peak flow rate for a 1-year design storm. This estimate was based on disinfection capabilities observed during Newell St. Disinfection Pilot (1999), the Spring Creek, NY Disinfection Pilot (1991), and the 1970's EPA study (EPA, 1979).

Hourly fecal coliform bacteria loads from the nine CSO Regional Facilities were added to identify the total CSO fecal loading to Onondaga Creek, Harbor Brook and Ley Creek. These loads in addition to background bacteria loading estimated from previous monitoring represented the total fecal coliform bacteria loading that entered Cell #1 in the model. The background loading was determined by computing the background streamflow and multiplying it by background concentrations. The background fecal concentration of 1,000 cfu/100 ml was used for these analyses

Bacteria loads were not developed for Trib. 5a, Bloody Brook, Ninemile Creek and Sawmill Creek since these sources represent a negligible contribution of bacterial loading entering the Lake. Continuous bacteria loading rates of 4.01e+12, 2e+11, and 1e+11 cfu/day were used for Ninemile Creek, Bloody Brook, and Sawmill Creek, respectively, to represent average in-stream fecal loading. These data were taken from the 1987 bacteria monitoring effort.

LAKE BACTERIA STANDARDS

Bacteria standards are derived from federal, state, and local interpretation. The federal CSO Policy allows for four overflow events per year with a provision for the permitting agency, in this case NYSDEC, to permit two more events per year. Such overflow events can cause bacterial violations in the Lake depending upon the severity of the rainfall event if the state ambient water quality requirements are not violated. The ACJ specifically requires compliance in Class "B" waters only.

The acknowledged dry-weather standard for bathing beaches indicates a fecal coliform bacteria violation exists when the logarithmic mean of colony forming units (cfu) exceeds 200 cfu/100 ml over a period of five consecutive days or 1000 cfu/100ml for any measurement. Given the condition of violation, a beach area could not be reopened unless there was two consecutive days where the bacteria concentrations were below 200 cfu/100ml per a Draft of Bathing Beach Issues (10/7/91). The difficulty with these standards is defining what represents a wet-weather violation. Presently, the State does not have wet-weather standards associated with fecal coliform bacteria.

For the purposes of this evaluation, a bacteria violation is defined as when Lake concentrations exceed 200 cfu/100 ml on and instantaneous basis.

MODEL RESULTS

The modeling results depict the fecal coliform concentrations throughout the Lake for the existing conditions, pre-CSO abatement and following implementation of the ACJ CSO abatement program. The results of this analysis, as shown in Table 2, show the projected number of annual violations and peak fecal concentrations in each Lake model cell.

Table 2. Bacteria Model Results

	Existing		Following CSO Abatement	
	Number of Exceedances	Peak Concentration cfu/100 ml	Number of Exceedances	Peak Concentration cfu/100 ml
Cell #1	21	2,515	7	500
Cell #2	13	1,420	0	< 200
Cell #3	12	900	0	< 200
Cell #4	8	610	0	< 200
Cell #5	5	390	0	< 200
Cell #6	2	320	0	< 200
Cell #7	1	290	0	< 200
Cell #8	1	280	0	< 200

* Hours and Number of violations are based on any projected in-Lake concentration that exceeds 200 cfu/100 ml

This analysis demonstrates compliance with bacterial concentrations throughout the Class "B" sections of the Lake. Cell 1 exceedances of the 200 cfu/100 ml standard may occur following large storms. Cell 1 is the southernmost cell of the Lake and receives CSO inputs. This cell is classified as "C" in Onondaga Lake. Recall that "compliance" is conservatively defined as bacteria cells less than 200 cfu/100 ml, when the bathing beach standard allows for up to 1,000 cfu/100 ml before beach closure is required.

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APPENDIX C

MEMORANDUM-METRO HEADWORKS ANALYSIS/IMPACT OF KIRKPATRICK STREET PUMP STATION

MEMORANDUM

ENVIRONMENTAL ENGINEERING ASSOCIATES, LLP

To:	Michael Cunningham, Director Lake Improvement Project Office	cc:	R. L. Elander	–	OCDDS
			R. Ott	–	OCDDS
			S. Martin	–	OCDDS
From:	C.R. Smithgall, P.E. A.H. Steinhauer, P.E. R. Butterworth, P.E.		B. Duclos	–	C&S
			R. Ganley	–	EEA
			D. Geisser	–	EEA
			J. Swanson	–	EEA
Re:	METRO Headworks Analysis/Impact of Kirkpatrick Street Pump Station		R. Butterworth	–	EEA
Date:	August 17, 2000				

This memorandum has been prepared to address a number of wet weather flow management issues as related to the design and operation of the Kirkpatrick Street Pump Station (Kirkpatrick Street Pump Station) and its potential impact on the Metropolitan Syracuse Treatment Plant (METRO). The intent of this memorandum is supplement information contained in the 30 Percent Design Report and preceding "Sewer Study Report for the Kirkpatrick Street Pumping Station Service Area" (EEA, July 1999). One of the main tasks was to evaluate the influent channel hydraulics considering anticipated flows from the proposed upgraded Kirkpatrick Street Pump Station. This memorandum includes a discussion of the peak flows currently directed to METRO and whether or not potential force main connection points may or may not result in a METRO bypass.

The issues that will be addressed in this memorandum include:

existing conditions including existing facilities and existing flow rates

tie-in location for the new force main from the Kirkpatrick Street Pump Station

the impact of additional Kirkpatrick Street Pump Station flow on potential METRO bypassing

wet weather operational procedures for the Kirkpatrick Street Pump Station

potential impacts on wet weather flow relief associated with the proposed expansion of the Carousel mall expansion project and mitigative measures

Each are discussed in greater detail below

A Existing Conditions.

1. **Background.** The METRO service area represents a combination of separately sewered and combined sewered areas. During intense precipitation events and snowmelt events the flows directed to METRO can exceed the 240 mgd capacity of the plant and untreated bypasses of the plant occur.

   The existing Kirkpatrick Street Pump Station has a usable capacity of 7 cfs (4.5 mgd). Whereas flows above that rate can be pumped, they result in surcharging and loss of flow at the discharge manhole location at the Syracuse Parks and Recreation facility. The intent of this project is to provide an upgrade of the station so that it can effectively transmit flow to METRO to eliminate overflows from CSO 075 for a one-year storm and to provide potential for pumping flows up to the two-year storm in the event that overflow CSO 075 is closed with expansion of the Pyramid Mall. The proposed upgrade of the Kirkpatrick Street Pump Station will increase the discharge capacity from the facility from approximately 7 cfs (4.5 mgd) to 35 cfs (22.6 mgd). The project will allow approximately 28 cfs (18.1 mgd) to be directed toward METRO. This would be a 7.5 percent increase over the existing METRO design flow rate of 240 mgd. The fact that peak flow rates seldom coincide in time from the other METRO influent sources means that the pump station upgrade project will allow for greater pollutant capture and environmental improvements if it were constructed for only a one-year storm (the basis for other Onondaga County CSO improvement projects).

2 **Existing Facilities.** Influent flows to the headworks at METRO currently come from the following sources as shown on Figure 1.

   Main Interceptor Sewer (MIS) – presently includes flow from Kirkpatrick Street Pump Station
   Harbor Brook Pump Station
   Ley Creek Pump Station Force Main
   Liverpool Pump Station Force Main
   West Side Pump Station Force Main

   Flow from the MIS and the Harbor Brook Pump Station enter one leg of a wye shaped structure, called the Diversion Structure, and are directed to the New Screenings and Grit (NSG) Building (design capacity 150 mgd). Flows from the Ley Creek, Liverpool and West Side Pump Station force mains enter the other leg of the Diversion Structure and are directed to a second independent influent screening and grit removal facility called the Existing Screen and Grit facility or Existing Screenings and Grit (ESG) Building (reported capacity approximately 90 mgd). The two legs of the Diversion Structure are isolated from each other by a sluice gate. The sluice gate is normally maintained in the closed position and has an overflow above it. The overflow allows flow to pass from one leg of the Diversion Structure to the other upon high flow depth occurring in either side.

Flow leaving the Diversion Structure, heading to the NSG, enters the Overflow Structure. In the Overflow Structure, one side of the NSG influent channel has roughly 80 feet of overflow weir. Any flow overtopping this weir bypasses the plant and is discharged untreated directly to Onondaga Lake through a 96-inch box culvert, Outfall 001. Under the recently completed METRO Odor Control and Residuals Handling Project, the NSG influent mechanical bar racks were modified to change the clear spacing from 3 inch to 1-½ inch. This was done to protect new grit collection and removal equipment installed downstream of the NSG influent mechanical bar racks.

The NSG influent channel enters the NSG building below grade. Upon entering under the NSG influent mechanical bar rack room, the influent channel splits into two channels. Each channel has an inlet isolation sluice gate followed by a mechanical bar rack. The NSG facility also includes two aerated grit chambers and two effluent mechanical screens. Flow is recombined after the effluent screens and exits the NSG in a single channel.

Flow entering the ESG facility is divided into three channels. Each channel has an inlet isolation sluice gate followed by a manually cleaned bar rack (bar rack clear spacing recently decreased to roughly 1¼-inch to protect new downstream grit collection and removal equipment). The ESG has only manually cleaned bar racks because the pump stations typically discharging to the ESG (Ley Creek, Liverpool, and West Side) have screening equipment. The ESG includes three aerated grit chambers. Flow exits the ESG in a single channel.

The effluent channels from the NSG and ESG combine into a single channel prior to entering the Low Lift Pump Station wet well. The Low Lift Pump Station transfers flow to the Primary Clarifier Distribution Structures (two structures). The Low Lift Pump Station includes five variable speed pumps (maximum of four operating with one standby). The design capacity of the Low Lift Pump Station is approximately 240 mgd (NSG 150 mgd + ESG 90 mgd = 240 mgd). However, testing conducted in 1992 by OCDDS and C&S indicated a maximum pumping capacity of roughly 250 mgd with four pumps operating and "normal" operating wet well level.

3. **Existing Flows.** METRO influent conditions are summarized for the NSG and ESG for the one-year storm basis of design. It should be noted that the peak rates associated for the one- and two-year storm events are similar based upon modeling performed by Moffa & Associates. This is due to the many relief points that are located in the MIS and Harbor Brook Interceptor Sewer (HBIS) portions of the combined sewer system.

Flows tributary to the NSG Side of Diversion Structure include the MIS and HBIS as follows:

Peak Flow	mgd
MIS	120
HBIS	30
Total Flow	**150**

Flows tributary to the ESG Side of Diversion Structure are all pumped influent from sanitary sewered portions of the service area. Whereas they are subject to varying levels of infiltration and inflow their wet weather flow rates cannot be predicted as well as those tributary to the NSG. The design flow rates for these pump stations have, therefore, been used to predict worst case flow rates to the METRO plant.

Maximum Capacity	mgd
Ley Creek Pump Station	60
West Side Pump Station	28
Liverpool Pump Station	8 (1)
Total Flow	96 (2)

(1) *Flow from the Liverpool pump station is limited to 6 mgd by the force main.*

(2) *Present possible total flow to the ESG facility is 94 mgd.*

As a result, the present peak flow that could be expected to be directed to the METRO headworks for a one-year storm event is 244 mgd (150+94). The above rate should be considered to be conservative since there are no known occurrences when all three pump stations have operated at maximum capacity simultaneously (94 mgd).

All flows to METRO that are not bypassed must go through the Low Lift Pump Station. This station, with four pumps operating, has a design capacity of 240 mgd. As noted above a pumping rate of approximately 250 mgd was achieved based on tests performed in 1992.

B. **Tie-in Location for New Pump Station Force Main.** An evaluation was performed to determine the best points for the discharge from the proposed Kirkpatrick Street Pumping Station force main at METRO. Both physical and hydraulic features were considered as noted below.

1. **Physical Tie-in Location.** Currently, flow from the Kirkpatrick Street Pump Station (prior to upgrade) reaches METRO as part of the MIS flow and is directed to the NSG facility. Future flow from this pump station (after upgrade) will be conveyed to METRO using the following two separate force mains. The dry weather flow will be discharged to the MIS by way of a new force main. The terminus of this force main will be at the intersection of Kirkpatrick Street and Van Rensselaer Street. Wet weather flows will be discharged to the headworks at METRO by way of a new force main located along Van Rensselaer Street.

   Consistent with other pump stations discharging flow to the headworks (ESG facility) at Metro, the upgraded Kirkpatrick Street Pump Station will not include grit removal equipment but will provide screening of flows. Consequently, flows from Kirkpatrick Street will have a similar pretreatment as that provided by other facilities discharging to the ESG.

   Based on review of METRO record drawings and the new force main approaching METRO from the south and then westward along the northern side of Hiawatha Boulevard, it appears that the most feasible physical locations for tie-in of the force main are:

   either the NSG or ESG side of the Diversion Structure

   after the NSG influent mechanical bar racks at the north side of the NSG grit chambers flow distribution box

   These potential routes have been shown on Figure 2. The optimum physical location for tie-in of the Kirkpatrick Street Pump Station force main appears to be at the Diversion Structure upstream of the NSG and ESG facilities (Option 1 as shown on Figure 2).

2. **Hydraulic Tie-In Location.** The new force main could be tied in at the Diversion Structure as described above, and be directed to either the NSG or ESG facilities. Influent flow at METRO is monitored and recorded downstream of the Low Lift Pump Station. Information on the actual historical peak and average influent flows for the NSG and ESG facilities are not available.

The additional flow that will be directed to METRO is 28 cfs as noted below:

Kirkpatrick Street Pump Station:

Proposed Future Peak Contribution to Headworks (via force main)	22.6 mgd (35 cfs)
Present Peak Contribution to Headworks at METRO (via the MIS)	4.5 mgd (7 cfs)
Increase in Peak Flow to Headworks	18.1 mgd (28 cfs)

The following flows were established as the current peak and average flow conditions for the headworks at METRO to evaluate the potential impact on NSG flow capacity. These flows were based on the change in clear spacing to the NSG influent mechanical bar racks (changed from 3-inch to 1½-inch clear spacing).

Present Peak Flow Condition	mgd
NSG	150
ESG	90
Combined Flow to Low Lift Pump Station	240

Present Average Flow Condition [1]	mgd
NSG	75
ESG	45
Combined Flow to Low Lift Pump Station	120

[1] *Half of peak flow condition used.*

A model was developed by EEA to evaluate the hydraulic conditions at the upstream end of the Overflow Structure Plant Bypass weir and NSG side of the Diversion Structure. The existing physical layout from the Low Lift Pump Station back through the NSG facility to the Diversion Structure, and estimated peak and average flow conditions, were used in the calculations. Record drawing information and site observations were used to define the physical layout.

An analysis was performed based on 1½-inch clear spacing for the NSG influent mechanical bar racks and for scenarios when these bar racks are clean, ¼ blocked and ½ blocked and the NSG effluent mechanical screens are clean and ½ blocked. The design discharge capacity of 240 mgd and a high wet well operating level elevation of 364.75 (elevation at which the fourth pump comes on) were used for the Low Lift Pump Station.

Under the peak NSG flow condition (150 mgd), with addition of peak flow (22.6 mgd) from the Kirkpatrick Street Pump Station, the total flow to the NSG facility would be 172.6 mgd. It was determined that diversion of flow to the NSG would likely cause overtopping of the plant bypass weir and increase the frequency of bypass events.

In order to evaluate the potential impact of routing the flow from the Kirkpatrick Street Pump Station to the ESG side of the Diversion Structure, the County tasked Moffa & Associates with developing a similar model, as was developed by EEA for the NSG side. The model developed by Moffa & Associates accounted for the existing physical layout from the Low Lift pump station back through the ESG facility to the Diversion Structure. Record drawing information and site observations were used to define the physical layout.

A worse case peak ESG flow rate of 96 mgd (all three existing pump stations discharging at maximum capacity and Liverpool force main no longer flow limiting) was used in conjunction with the proposed peak flow from the Kirkpatrick Street Pump Station of 22.6 mgd. This would produce a theoretical peak flow rate of 118.6 mgd at the ESG. Assuming the discharge capacity of the Low Lift Pump Station is not exceeded, the flow depth in front of the influent manual bar racks would be approximately 366.6'. The floor elevation in the ESG is 370.0'. Therefore, the ESG building would not flood. The overflow separating the two sides of the Diversion Structure is at Elevation 369.0'. Flow depth at the Diversion Structure overflow location would be approximately 367.2'. Therefore, flow would not pass from the ESG to the NSG side of the Diversion Structure.

Based upon the above information, the optimum hydraulic location for tie-in of the Kirkpatrick Street Pump Station force main has been determined to be at the ESG side of the Diversion Structure upstream of the NSG and ESG facilities.

C. Evaluation of Impacts of Additional Flow on METRO Flow Bypassing.

1. **Analysis of LLPS Flow Records.** As discussed earlier in this memorandum, the proposed upgrade of the Kirkpatrick Street Pump Station will result in additional flow being directed to METRO. OCDDS expanded the scope of this project to allow an assessment of the potential impact that this flow would have on increasing the frequency and magnitude of untreated plant bypasses. EEA directed the county's modeling consultant to perform analyses that would assist in determining the magnitude of this potential problem. A technical memorandum was produced and has been included as Appendix A of this memorandum.

The approach was to utilize existing wastewater flow records at METRO, tributary pump stations in conjunction with continuous long-term simulation of flows from the Kirkpatrick Street Pump Station service area to predict the increase in peak hourly flow rates at METRO, which might cause bypassing. It was estimated that a bypass situation would exist at METRO when flows exceed 240 mgd to the low lift pump station.

A period of record of January 1987 through March 1992 was selected based upon the availability of flow records and the status of other pump station improvement projects in the contributory system. A database of flow information was constructed to represent the peak hourly and average daily flow flows at METRO. The peak hour flow data was then sorted to determine those days when the flow rate exceeded either 240 mgd or 227 mgd. The latter number represents a threshold value at METRO for which additional flow from the Kirkpatrick Street Pump Station (during a one-year storm) would potentially induce a bypass.

A total of three historical events were identified as having peak hourly flows in excess of the 227 mgd threshold value. One of these events had a rate in excess of 240 mgd and would have been causing a bypass without the addition of the supplemental pump station flow. This latter event resulted from a large precipitation event in July 1988. One of the three events was an early spring event where high collection system infiltration rates were probably a significant portion of the total flow for that day.

2. **Long-Term Simulation of Kirkpatrick Street Pump Station Service Area.** The magnitude of additional flow from the Kirkpatrick Street Pump Station service area that would be diverted to METRO with the proposed improvements was projected using long-term continuous simulation models and local rainfall data. The model was the same tool that was developed, calibrated, and validated during the sewer study portion of this project. The same period of record used for the METRO peak hourly flow dataset was used for this evaluation. An evaluation of the rainfall distribution for this time period shows that the precipitation was representative for average conditions in the Syracuse area.

3. **Projected Frequency of Bypass Occurrences.** The additional flow from the Kirkpatrick Street Pump Station Service Area was added to the historical METRO flow database to determine whether additional plant bypasses could be expected with the addition of flow to METRO from this project. Information on the six largest events was presented in Appendix A. Only one of the six events has a projected total flow rate in excess of 240 mgd. The addition of 7.1 mgd of flow from the Kirkpatrick Street Pump Station resulted in a total expected METRO influent flow of 249 mgd. Whereas this project would not have induced an overflow event by itself, it would have added to the volume, which would have bypassed the plant. Another event had a projected total flow rate of 240 mgd, the capacity at which an overflow might have occurred. The remaining

events were considerably less than 240 mgd. It can be concluded, based on the above analysis, that the frequency of plant bypassing will remain at approximately once per five or six years and that there may be some small increase in the volume of bypassed flow.

Projections show that the CSO volume that will be captured as a result of this project will be approximately 20 million gallons annually. These reductions more than offset the volume of flow that would be bypassed at METRO. As a result, there is a net environmental gain with the expansion of the pump station capacity and construction of the force main to METRO.

D. **Wet Weather Operational Procedures for the Kirkpatrick Street Pump Station.** As noted in Section C, the proposed Kirkpatrick Street Pump Station project will result in additional flow to METRO and will slightly increase the frequency of occurrence and magnitude of plant bypasses if supplemental measures are not enacted. These flows can be controlled to a certain extent through a series of improvements to the METRO control system.

The following plan has been developed for the control of peak flow rates generated by the Kirkpatrick Street Pump Station Upgrade Project using the existing collection system facilities. This plan will manage the pumped flow from the upgraded pump station to prevent overflowing of the weir in the existing screening and grit chamber at METRO. The plan was developed in conjunction with collection system modeling discussed above.

1. **Level Sensing and METRO SCADA System.** A level sensor will be installed adjacent to the overflow weir at the ESG to detect when the flow level at this structure is approaching the discharge level. This signal will be tied into the METRO control system and will activate an alarm. One of these actions will be to control the influent flow from the upgraded Kirkpatrick Street Pump Station.

2. **Control of Kirkpatrick Street Pump Station Flows.** During those infrequent periods when the METRO ESG is approaching a bypass condition, the Kirkpatrick Street Pump Station flow will be throttled back, as noted above, to reduce the potential of a bypass situation that could be caused by the Kirkpatrick Street Pump Station. The proposed variable frequency drives at the upgraded pump station will provide flexibility for this purpose.

   The effective range of flow management at the Kirkpatrick Street Pump Station has been determined through modeling of the system. With the collection system as it currently exists, before the potential expansion or the Carousel Mall, flow could be relieved out of CSO 075 at Hiawatha and Solar Streets. Flows at the pump station can be reduced from 28 cfs to 20 cfs and still prevent an overflow event at CSO 075 at the one-year storm level. Flow reductions beyond this point, or for larger storm events, will result in an overflow at CSO 075, or surcharging conditions in the collection system.

3. **Diversion of Excess Wet Weather Flows to the Hiawatha RTF.** The basis of design for the pump station upgrade project was established at 35 cfs as documented in the January 2000 Engineering Design Report (30 percent). This basis was selected so that the county could direct more wet weather flow to METRO, and thus, minimize the impacts of CSO discharges above the one-year storm event. Concurrent with any flow throttling at the Kirkpatrick Street Pump Station, additional measures should be taken to minimize excessive flows in the Hiawatha Trunk Sewer. The manner in which to do this is to retain more of the wet weather flow in the upper Hiawatha Trunk Sewer and divert it for treatment at the Hiawatha RTF.

   For large storm events where flow throttling is necessary at the Kirkpatrick Street Pump Station, it is recommended that flows be diverted to the Hiawatha RTF. At that facility, they will be either treated and discharged or stored for subsequent treatment at METRO. The county has recommended that specific measures and evaluations for control of excess flows, as noted in the 30 Percent Design Report, be postponed pending putting the Hiawatha RTF into operation. These measures may include the replacement of orifice plates at the new overflow control structures on Spring, Carbon, and North Salina Streets. Additional control measures would be required to divert more of the flow in the Hiawatha Trunk Sewer, such as a sluice gate, inflatable dam, or fixed orifice structure at CSO 074.

4. **Modifications to CSO 075.** Modifications will be required to CSO 075 to meet the requirements of no overflows below a one-year storm event. A masonry weir will have to be constructed in the overflow manhole at the intersection of Hiawatha Boulevard and Solar Street. The elevation of this weir has been tentatively established at elevation 8.03 (Syracuse City Datum).

An alternate approach to throttling of Kirkpatrick Street Pump Station flows would be to plan to discharge wet weather flows to the tertiary tanks at METRO. These tanks will be available for storage of wet weather flows following the METRO Treatment Plant Upgrade Project. Utilizing these tanks would allow the Kirkpatrick Street Pump Station to deliver up to 35 cfs to METRO, thus providing treatment of flows up to the two-year storm event. The pumps for the Kirkpatrick Street Pump Station have been designed to accommodate this alternate approach.

E. **Potential Impacts of Wet Weather Flow Relief Associated with the Proposed Carousel Mall Expansion Project and Mitigative Measures.** The potential expansion of the Carousel Mall will require the relocation of the Hiawatha Trunk Sewer and will eliminate CSO 075. If the mall expansion project goes ahead, the issue of wet weather flow management becomes critical. It will be necessary to provide relief of excess flow in the system that is currently being provided at CSO 075. There are a number of potential approaches that can be used:

1 Divert and treat excess flows at the Hiawatha RTF. This approach is discussed in Section D.4 above.

2. Provide capacity in the rebuilt Hiawatha Trunk Sewer to transport the excess flow to Kirkpatrick Street Pump Station where it would be relieved as necessary. This would likely happen only at events above that of a two-year storm.

3. Provide storage of the excess flow by either constructing stand-alone storage or provide for in-line storage by oversizing the replacement trunk sewer pipe.

A preliminary analysis was performed to determine the potential for using an upgraded Hiawatha Trunk Sewer for shaving peak flows at the Kirkpatrick Street Pump Station. A minimum required capacity of 42 cfs has been determined through collection system modeling to relocate CSO 075 to the vicinity of the Kirkpatrick Street Pump Station. Providing this capacity in the Hiawatha Trunk Sewer would require a pipe diameter of 48 inches for a five-year storm basis of design. This storm is the largest that can be accommodated by the Hiawatha Trunk Sewer system. Storm events of greater magnitude cannot enter the system.

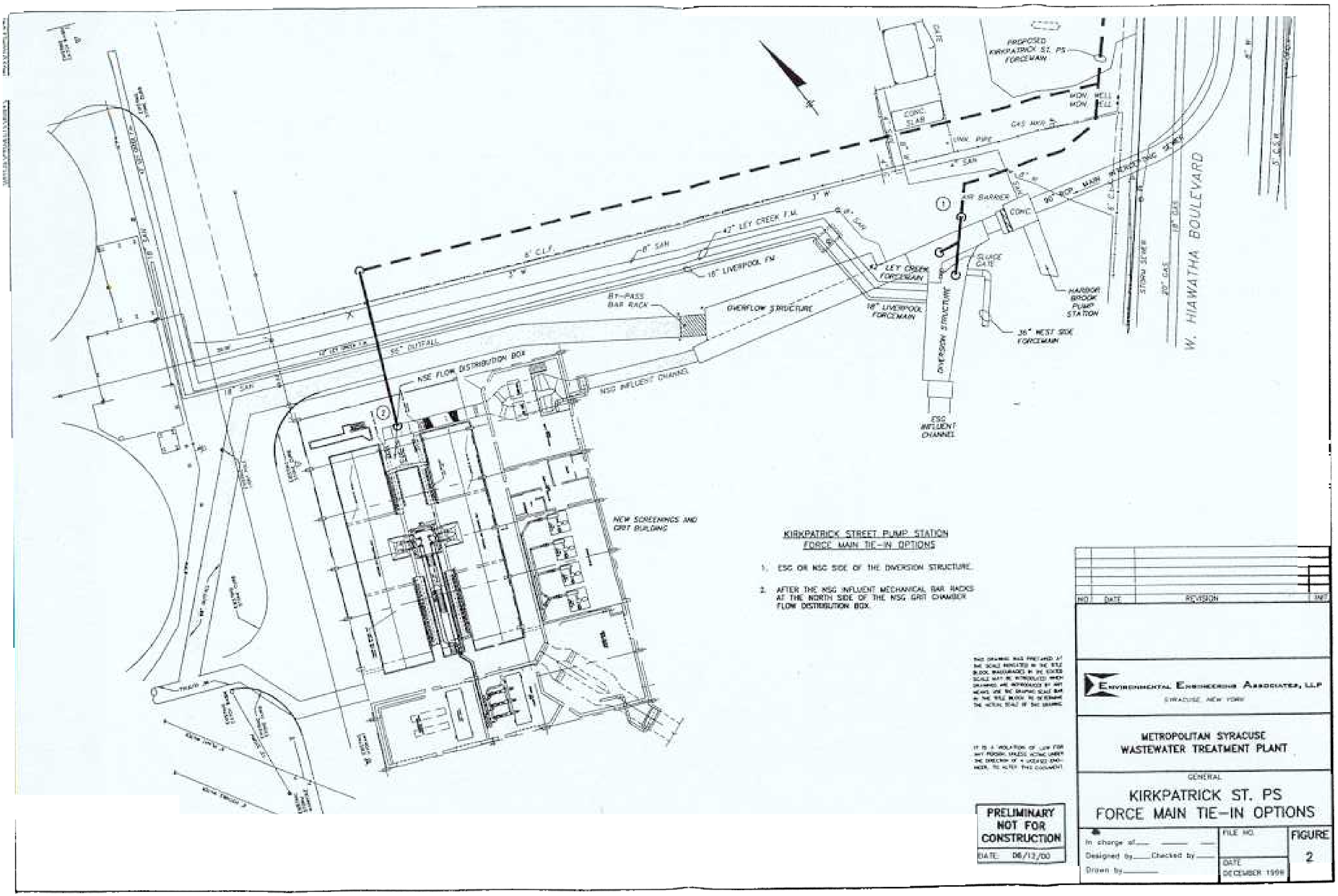
Four different pumping rates were used:

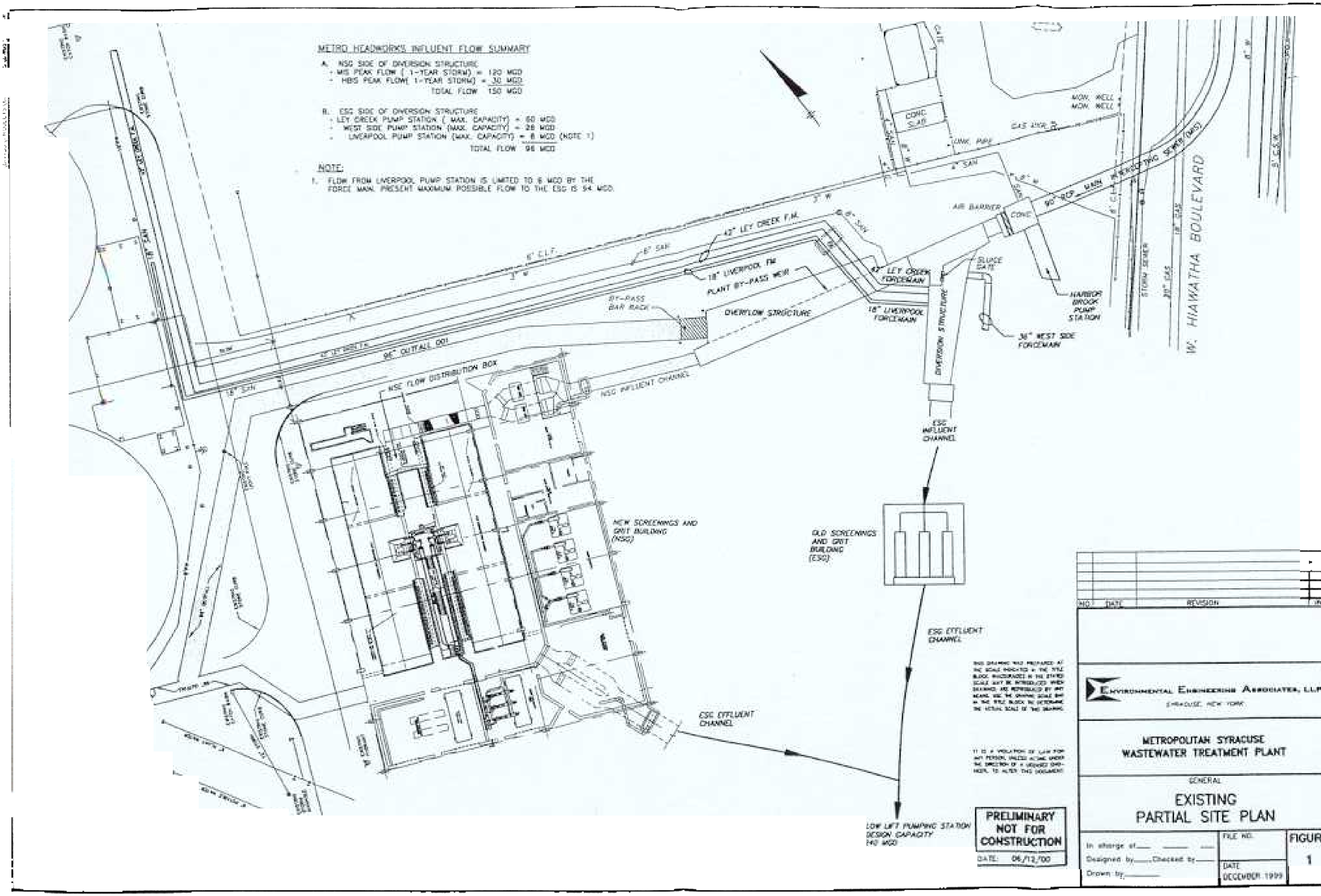
35 cfs – reflective of a two-year storm peak flow
28 cfs – reflective of a one-year storm peak flow
20 cfs – reflective of a moderate degree of flow throttling
10 cfs – reflective of a high degree of flow throttling

The 1-, 2-, and 5-year storm hydrographs were analyzed to determine the required storage capacity of the trunk sewer and respective diameters determined for each scenario. It was determined that excess flows could be stored in the 5,500 feet of trunk sewer that would be constructed. Required pipe diameter varies from the minimum 48-inch diameter pipe to 84-inches for the most restrictive situation, as shown on the following table (10 cfs pumping rate and a five year storm).

	HTS Diameters Required for Storage of Design Storms		
Pump Rate	**One-Year**	**Two-Year**	**Five-Year**
10 cfs	54"	54"	84"
20 cfs	48"	48"	60"
28 cfs	48"	48"	54"
35 cfs	48"	48"	54"

The decision as to what diameter the Hiawatha Trunk Sewer should be tied into the evaluations will be made following the startup of the Hiawatha RTF and the actual decision to build the mall expansion project. At that point, the appropriate balance between required transmission and CSO treatment capacity can be made.


PROPOSED KIRKPATRICK ST. PS FORCEMAIN
MON. WELL
MON. WELL
GAS MH
CONC SLAB
GATE
UNK. PIPE
4" SAN
AIR BARRIER
CONC
90" RCP MAIN INTERCEPTING SEWER
W. HIAWATHA BOULEVARD
STORM SEWER
18" GAS
20" GAS
HARBOR BROOK PUMP STATION
SLUICE GATE
36" WEST SIDE FORCEMAIN
DIVERSION STRUCTURE
ESG INFLUENT CHANNEL
42" LEY CREEK FORCEMAIN
18" LIVERPOOL FORCEMAIN
42" LEY CREEK F.M.
18" LIVERPOOL FM
8" SAN
6" C.L.F.
BY-PASS BAR RACK
OVERFLOW STRUCTURE
96" OUTFALL
NSE FLOW DISTRIBUTION BOX
NSG INFLUENT CHANNEL
18" SAN
NEW SCREENINGS AND GRIT BUILDING
KIRKPATRICK STREET PUMP STATION
FORCE MAIN TIE-IN OPTIONS
1. ESG OR NSG SIDE OF THE DIVERSION STRUCTURE.
2. AFTER THE NSG INFLUENT MECHANICAL BAR RACKS AT THE NORTH SIDE OF THE NSG GRIT CHAMBER FLOW DISTRIBUTION BOX.
NO. DATE REVISION
ENVIRONMENTAL ENGINEERING ASSOCIATES, LLP
SYRACUSE, NEW YORK
METROPOLITAN SYRACUSE WASTEWATER TREATMENT PLANT
GENERAL
KIRKPATRICK ST. PS
FORCE MAIN TIE-IN OPTIONS
PRELIMINARY NOT FOR CONSTRUCTION
DATE: 06/12/00
In charge of
Designed by
Checked by
Drawn by
FILE NO.
DATE DECEMBER 1999
FIGURE 2


METRO HEADWORKS INFLUENT FLOW SUMMARY
A. NSG SIDE OF DIVERSION STRUCTURE
- MIS PEAK FLOW (1-YEAR STORM) = 120 MGD
- HBIS PEAK FLOW(1-YEAR STORM) = 30 MGD
TOTAL FLOW 150 MGD
B. ESG SIDE OF DIVERSION STRUCTURE
- LEY CREEK PUMP STATION (MAX. CAPACITY) = 60 MGD
- WEST SIDE PUMP STATION (MAX. CAPACITY) = 28 MGD
- LIVERPOOL PUMP STATION (MAX. CAPACITY) = 8 MGD (NOTE 1)
TOTAL FLOW 96 MGD
NOTE:
1. FLOW FROM LIVERPOOL PUMP STATION IS LIMITED TO 6 MGD BY THE FORCE MAIN. PRESENT MAXIMUM POSSIBLE FLOW TO THE ESG IS 94 MGD.
W. HIAWATHA BOULEVARD
90" RCP MAIN INTERCEPTING SEWER (MIS)
STORM SEWER
AIR BARRIER
CONC
SLUICE GATE
HARBOR BROOK PUMP STATION
36" WEST SIDE FORCEMAIN
42" LEY CREEK F.M.
42" LEY CREEK FORCEMAIN
18" LIVERPOOL FM
18" LIVERPOOL FORCEMAIN
PLANT BY-PASS WEIR
BY-PASS BAR RACK
OVERFLOW STRUCTURE
DIVERSION STRUCTURE
96" OUTFALL 001
NSG FLOW DISTRIBUTION BOX
NSG INFLUENT CHANNEL
ESG INFLUENT CHANNEL
OLD SCREENINGS AND GRIT BUILDING (ESG)
NEW SCREENINGS AND GRIT BUILDING (NSG)
ESG EFFLUENT CHANNEL
ESG EFFLUENT CHANNEL
LOW LIFT PUMPING STATION DESIGN CAPACITY 240 MGD
CONC. SLAB
LINK PIPE
MON. WELL
MON. WELL
GATE
PRELIMINARY NOT FOR CONSTRUCTION
DATE: 06/12/00
NO. DATE REVISION
ENVIRONMENTAL ENGINEERING ASSOCIATES, LLP
SYRACUSE, NEW YORK
METROPOLITAN SYRACUSE WASTEWATER TREATMENT PLANT
GENERAL
EXISTING PARTIAL SITE PLAN
In charge of
Designed by
Checked by
Drawn by
FILE NO.
DATE DECEMBER 1999
FIGURE 1

MEMORANDUM

To Bob Butterworth **CC:** files

From: Dan Davis
Howard Goebel **Date:** 06/02/00

RE: Kirkpatrick St. Pump Station Design **File:** 150.05.04

An analysis of the METRO Wastewater Treatment Plant was conducted to determine the feasibility of conveying combined sewage flow from the proposed upgrade to the Kirkpatrick Street Pump (KSPS) to METRO for treatment. The average daily flow rate processed through METRO is reportedly 80 mgd with a peak capacity of 240 mgd.

The Low Lift Pump Station (LLPS) wet well receives the combined and sanitary flows and lifts it to the treatment process. This pumping station is equipped with five, vertical, non-clog pumps (4 duty, 1 standby). The LLPS has a nominal capacity of 240 MGD with 4 pumps running, although reportedly pump tests have demonstrated that approximately 250 MGD can be pumped under certain wet well levels. Flow in excess of the LLPS capacity is conveyed through an Emergency Bypass that consists of a series of eight, 10-foot long rectangular weirs that ultimately discharge to Onondaga Lake through outfall 001 with no treatment.

The existing Kirkpatrick Street Pump Station directs dry weather flow to the MIS approximately 3,200 feet upstream of the METRO headworks and has a reported capacity of 5 mgd. The proposed upgraded KSPS will have a total capacity of 18 mgd, with 5 mgd of dry weather flow directed to the MIS and the remaining 13 mgd of wet weather flow directed to the METRO headworks through a new force main. The primary benefit of conveying the proposed KSPS discharge to METRO is that the existing discharge from CSO 075 would be eliminated up to the 1-year design storm level and that wet weather flows processed through METRO would receive a minimum of primary treatment. The represents approximately 20 million gallons per year of existing CSO that would receive primary treatment at METRO.

FACILITY DESCRIPTIONS

The inputs to METRO and a representation of the METRO flow streams are depicted in a process flow schematic on Figure 1-4 (Proposed Municipal Compliance Plan, 01/11/96) and are summarized below:

Main Interceptor Sewer (MIS)

The MIS conveys flow to METRO from the Onondaga Creek drainage area. The downstream sections of the MIS have a horseshoe shaped cross-section, approximately 90 inches in diameter.

Harbor Brook Intercepting Sewer (HBIS) and Harbor Brook Pumping Station

The Harbor Brook Pumping Station services the west side of the City of Syracuse. This pumping station is equipped with three fixed speed pumps Archimedes screw pumps (2 duty, 1 standby). The maximum capacity of this pumping station is 30 MGD with 2 pumps running. The Harbor Brook Pumping Station discharges to the MIS, which flows to the New Screenings and Grit (NSG) side of the METRO headworks (OBG, Harbor Brook Pumping Station O&M Manual, 1979).

Ley Creek Pumping Station and Force Main

The Ley Creek Pumping Station services the Ley Creek service area, which is located in the northeast portion of the METRO service area. This pumping station is equipped with manually cleaned coarse bar racks (3"-inch spacing), mechanically cleaned bar screens (1-inch spacing), and three centrifugal, non-clog, variable speed pumps (2 duty, 1 standby). The maximum capacity of this pumping station is 60 MGD with 2 pumps running.

The Ley Creek Force Main consists of approximately 12,500 linear feet of 42-inch diameter PCCP, and discharges to the Existing Screenings and Grit (ESG) side of the METRO headworks. The capacity of this force main is 70 MGD. The travel time to METRO is approximately 62 minutes at an average daily flow rate of 19 MGD and 21 minutes at the anticipated peak flow rate of 56 MGD (BBL, Ley Creek Pumping Station O&M Manual, 1992).

Liverpool Pumping Station and Force Main

The Liverpool Pumping Station services the Liverpool service area, which is located in the northwest portion of the METRO service area. This pumping station is equipped with mechanically cleaned bar screens and three centrifugal, non-clog, variable speed pumps (2 duty, 1 standby). The maximum capacity of this pumping station is 8 MGD with 2 pumps running.

The Liverpool Force Main consists of approximately 17,400 linear feet of 18-inch diameter PCCP, and discharges to the Existing Screenings and Grit (ESG) side of the METRO headworks. The capacity of this force main is 6 MGD, and is pressure limited to 70 PSI. A 1 MG storage tank was constructed to store flows in excess of the force main capacity. The travel time to METRO is approximately 276 minutes at an average daily flow rate of 1.2 MGD and 58 minutes at the force main capacity of 6 MGD (CHA, Liverpool Pumping Station Service Area SSES, 1999).

West Side Pumping Station and Force Main

The West Side Pumping Station services the western portion of the METRO service area. This pumping station is equipped with a coarse trash rack, mechanically cleaned bar screen, and six, fixed-speed, submersible pumps. The maximum capacity of this pumping station is 28 MGD with 5 pumps running.

The West Side Force Main consists of approximately 10,600 linear feet of 36-inch diameter pipe, and discharges to the Existing Screenings and Grit (ESG) side of the METRO headworks. The travel time to METRO is approximately 89 minutes at an average daily flow rate of 9.3 MGD and 29 minutes at the maximum pumping capacity of 28 MGD (OBG, West Side Pumping Station Modifications O&M Manual, 1985 and PES Supplement to 1985 O&M Manual, 1997).

Diversion Structure

The METRO headworks contain a diversion structure to separate flows though the screenings and grit facilities. The "NSG side" accepts flow from the MIS and Harbor Brook Pumping Station and conveys it to the NSG. The "ESG side" accepts flow from the Ley Creek, Liverpool and West Side force mains and conveys it to the ESG. The two sides are normally isolated, although there is a sluice gate between the two sides of the structure that can act as a relief between the two sides (weir crest elevation 369.0' USGS).

New Screenings and Grit Facilities (NSG)

The NSG side of the METRO headworks starts downstream of the Diversion structure. Normally, flow continues past the Plant Bypass, a series of eight 10-foot long rectangular weirs (weir crest elevation 369.3' USGS), to the NSG building. The NSG building houses two mechanically cleaned bar screens with 1.5-inch openings, two grit chambers and two mechanically cleaned bar screens with 3/4-inch openings. The NSG and ESG flows are then combined upstream of the Low-Lift Pump Station (LLPS).

Existing Screenings and Grit Facilities (ESG)

The ESG side of the METRO headworks starts downstream of the Diversion structure. Flow is conveyed to the ESG that consists of three manually cleaned bar screens with 1.25-inch openings and three grit chambers. The NSG and ESG flows are then combined upstream of the LLPS.

Low Lift Pumping Station (LLPS)

The LLPS wet well collects the combined NSG/ESG flow and lifts it to the treatment process. This pumping station is equipped with five, vertical, non-clog pumps (4 duty, 1 standby). The LLPS has a nominal capacity of 240 MGD with 4 pumps running, although reportedly pump tests have demonstrated that approximately 250 MGD can be pumped under certain wet well levels.

LLPS FLOW EVALUATION

An evaluation was performed on the LLPS pumping records from January 1987 through March 1992. This period was selected since it was the only period of record where sufficient METRO flow data and corresponding hourly rainfall data exists since each the Ley Creek, Liverpool, and West Side pump stations have been upgraded. These years include dry, normal and wet rainfall years based on long-term rainfall statistics. The purpose of this evaluation was to identify the frequency that the rated capacity of the LLPS would be exceeded if the wet weather flow from the proposed KSPS were conveyed to the METRO headworks. The analysis consisted of establishing the frequency that the observed METRO flow rates plus the 13 mgd wet weather KSPS capacity exceeded the 240 mgd METRO capacity during the 6-year study period. The dry weather flow from the KSPS service area (5 mgd max) is included within the LLPS flow records.

A database was developed to assess the frequency of observed peak flows at METRO. The database consists of daily peak hourly, average daily hourly, and daily minimum hourly flow rates observed at METRO as well as the corresponding daily precipitation for the six-year period from January 1, 1987 through December 31, 1992. Annual plots of observed daily hourly peak flows at METRO are provided in Appendix I for the study period. This data demonstrated that flows at or near the 240 MGD LLPS capacity were rarely observed.

There was only a single day during the six-year study were the hourly peak flow processed through METRO was observed at or above the 240 MGD LLPS capacity. Furthermore, there were a total of three days where flow exceeded 227 mgd, which represents the LLPS capacity of 240 mgd minus the proposed 13 mgd KSPS wet-weather pumping rate. These data are shown on Table 1.

Table 1. Observed Peak Flow Rates at METRO in Excess of the 227 mgd (1987 – 1992).

Event	Date	Precipitation (in.)	Peak Hourly Flow (MGD)	Average Daily Flow (MGD)	Minimum Hourly Flow (MGD)
1	06/22/87	2.74	229.3	118.2	48.9
2	07/21/88	1.57	241.9	125.7	55.7
3	03/31/89	0.62	230.6	154.4	103.4

Events 1 (06/22/87) and 2 (07/21/88) were directly a result of rainfall-induced runoff. This can be seen by the low average daily and instantaneous flow rates as well as the high daily precipitation that occurred during the summer days where there was no influence of snowfall or snow pack. Event 3 (03/31/89) was likely a result of a rain on snow phenomena compounded with high groundwater levels. This can be seen upon inspection of the high average daily and minimum hourly flow rates where elevated flow rates were observed throughout the entire day. The low precipitation during this day indicates that these flows were not directly a result of wet-weather induced runoff.

Sewer system modeling was conducted to evaluate the impact of the proposed KSPS on METRO. Long-term continuous simulation using the EXTRAN block of SWMM was conducted for the six-year study period for the KSPS drainage area. Hourly rainfall data from the National Weather Service Station in Syracuse, New York at Hancock International Airport were used as the data input to this modeling. This study period would appear to be suitable based on a comparison of annual rainfall during this period to annual rainfall from a large period of record. Table 2 provides a listing of annual rainfall from the National Weather Service Station in Syracuse, New York at Hancock International Airport from 1949 through 1999.

Table 2. Annual Precipitation Statistics, Hancock International Airport, Syracuse, NY (1949 –1999)

Year	Total Preciptation (in)	Year	Total Preciptation (in)	Year	Total Preciptation (in)
1949	33.9	1966	33.1	1983	36.3
1950	37.6	1967	36.0	1984	36.7
1951	44.4	1968	44.2	1985	31.9
1952	31.4	1969	32.1	1986	42.9
1953	29.8	1970	38.2	1987	33.7
1954	43.4	1971	39.2	1988	34.4
1955	40.1	1972	55.4	1989	36.9
1956	41.9	1973	52.6	1990	49.5
1957	33.2	1974	50.3	1991	37.1
1958	42.8	1975	51.9	1992	43.6
1959	41.2	1976	58.3	1993	43.4
1960	32.2	1977	44.5	1994	37.3
1961	37.6	1978	35.1	1995	31.3
1962	30.7	1979	38.5	1996	39.4
1963	27.8	1980	32.1	1997	32.6
1964	27.1	1981	35.2	1998	37.1
1965	28.4	1982	35.1	1999	30.9
				Max	44.4
				Min	27.1
				Average	38.2

Note: The average precipitation during the 1987 – 1992 study period was 39.2 inches

These data demonstrate that the study period includes a variety of rainfall conditions, some dryer and some wetter than average conditions, and is representative of rainfall conditions observed throughout the 51 years of record.

The KSPS hourly flow data derived from the long-term continuous simulation was tabulated for each day of the study period and superimposed on the corresponding METRO daily peak hourly data to demonstrate the impact that would have resulted at METRO. The results of this analysis are summarized in Table 3.

Table 3. Peak Annual METRO and KSPS Flow Summary (1987 – 1992)

Event	Date	Precipitation (in.)	METRO Peak Hourly Flow (MGD)	KSPS Peak Hourly Flow (MGD)	Projected Combined Peak Flow (MGD)
			(1)	(2)	(1) + (2)
1	06/22/87	2.74	229.3	10.7	240.0
2	07/21/88	1.57	241.9	7.1	249.0
3	09/19/89	1.77	205.6	8.6	214.2
4	08/28/90	2.98	207.3	13.0	220.3
5	08/09/91	1.96	204.9	5.4	210.3
6	08/28/92	1.36	206.7	8.4	215.1

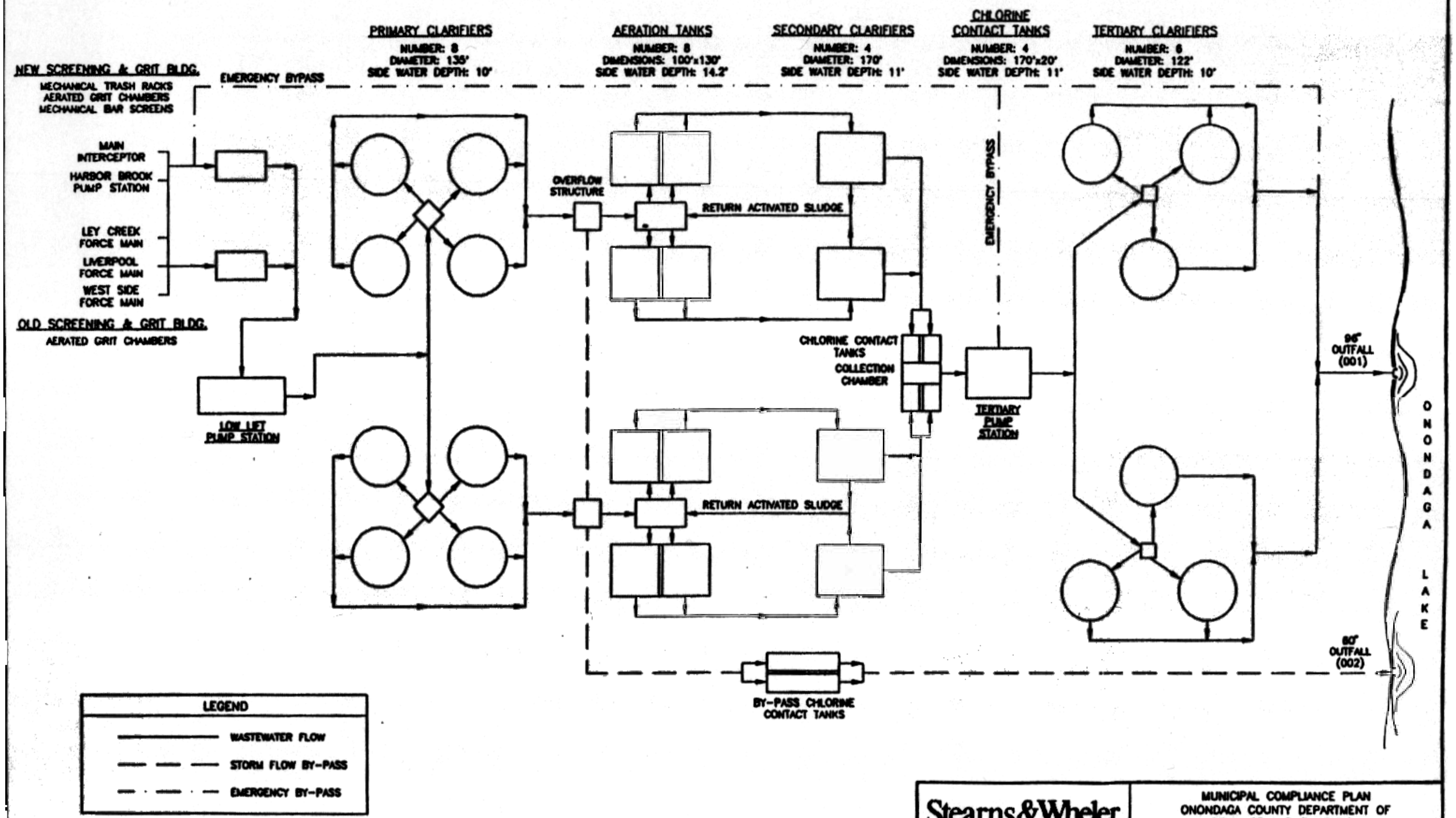
Note: The 3/31/89 event from Table 1 resulted in less than 1 mgd from the KSPS based on the low precipitation during that event.

This analysis shows that the impact of the proposed KSPS pump station would not result in an increased frequency of flow at METRO in excess of the 240 LLPS capacity. The single excursion (7/21/88) above the 240 mgd capacity occurred when the METRO flowrate was already above the 240 mgd LLPS capacity. Although the LLPS has demonstrated capacity in excess of 240 mgd, we have assumed that the KSPS flow that occurs when METRO exceeds 240 mgd results in a bypass. Under this assumption, the 7/21/88 event would have resulted in approximately 1 million gallons of overflow at the emergency bypass.

The long-term continuous simulation also identified that annually; approximately 20 million gallons of wet-weather flow that presently discharges through CSO 075 would be captured and processed through METRO. This wet-weather flow would minimally receive primary treatment, consistent with the federal CSO Policy of maximizing flow to the publicly owned treatment works (POTW).

Conclusions

These analyses indicate that METRO has the capacity to convey the additional 13 mgd KSPS wet weather flow in addition to the 5 mgd dry weather flow that is presently conveyed through the MIS for a total of 18 mgd from the KSPS drainage area. The frequency of occurrence of flows at or near the LLPS capacity is very low. The primary benefit of this project would be to convey the wet weather flow from the KSPS collection system that presently discharges through CSO 075 to METRO where it would receive, at a minimum, primary treatment. This would result in treating approximately 20 million gallons of CSO annually to a minimum of primary treatment. The METRO headworks would need to be reconfigured to convey the KSPS wet weather flow through the ESG since the NSG is presently fully subscribed.



Stearns&Wheler
ENVIRONMENTAL ENGINEERS & SCIENTISTS

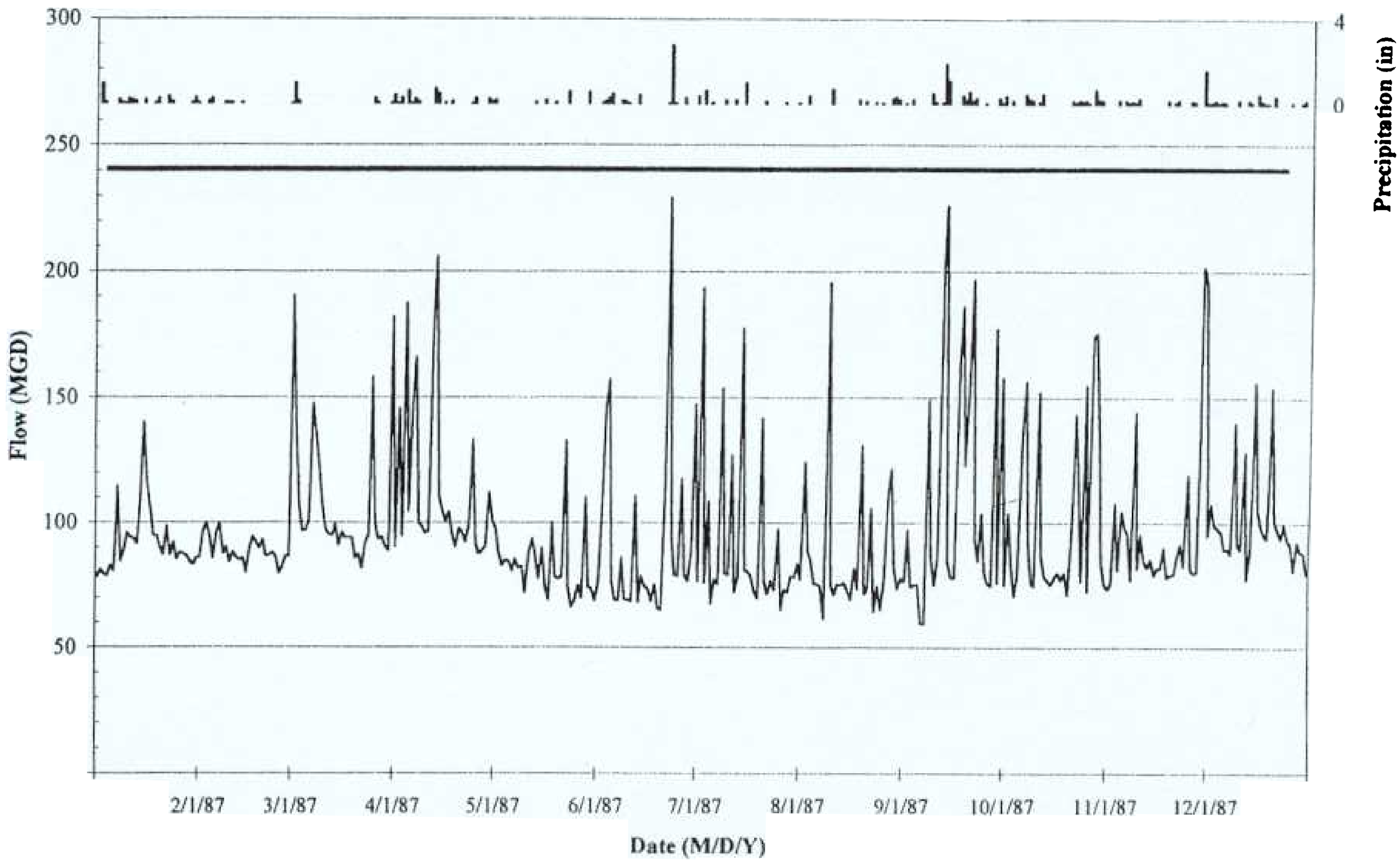
DATE: 1/11/96 JOB No.: 2298

MUNICIPAL COMPLIANCE PLAN
ONONDAGA COUNTY DEPARTMENT OF DRAINAGE AND SANITATION

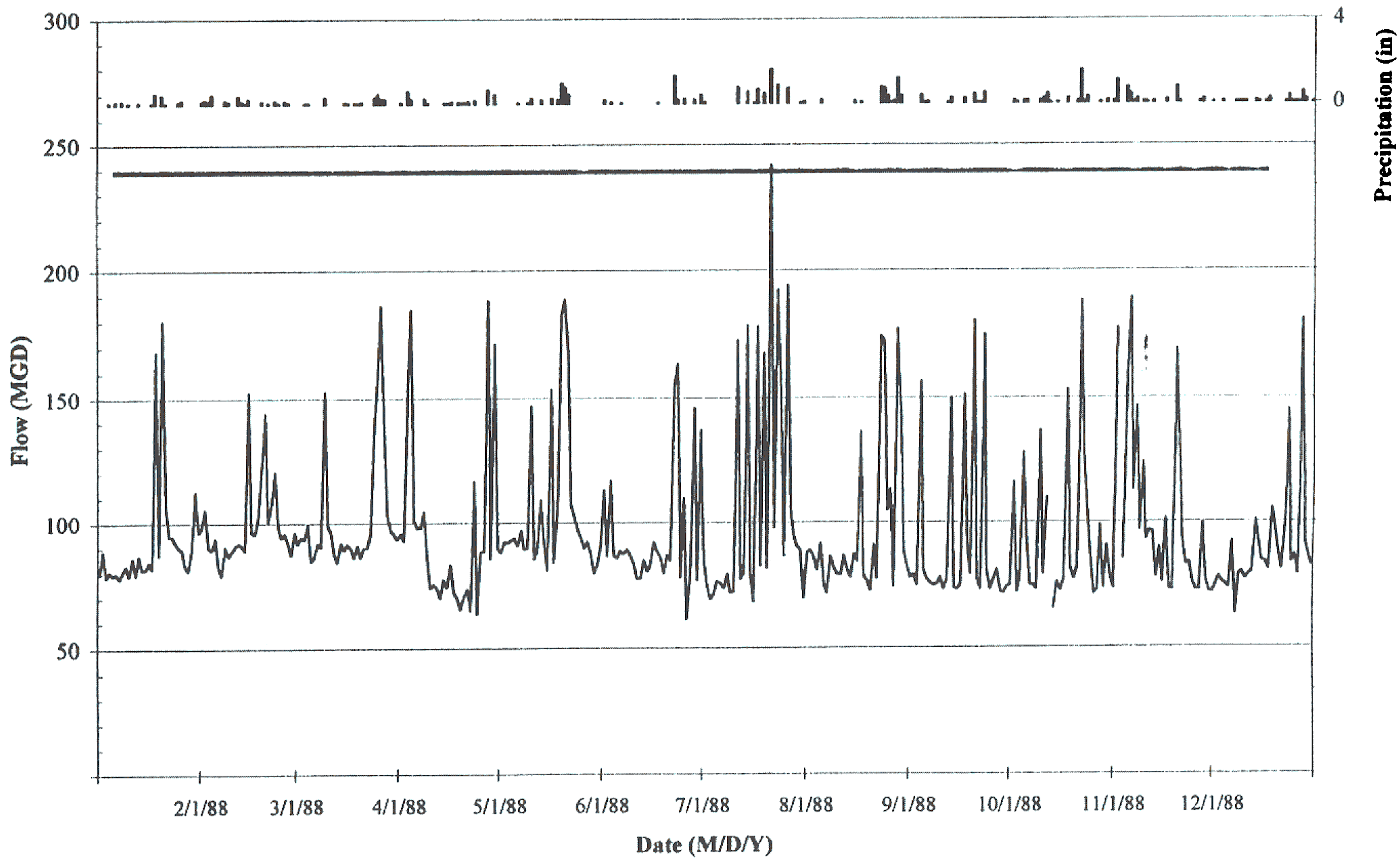
FIGURE 1-4
WASTEWATER PROCESS FLOW SCHEMATIC

APPENDIX I – Peak Daily Flows at METRO 1987- 1992

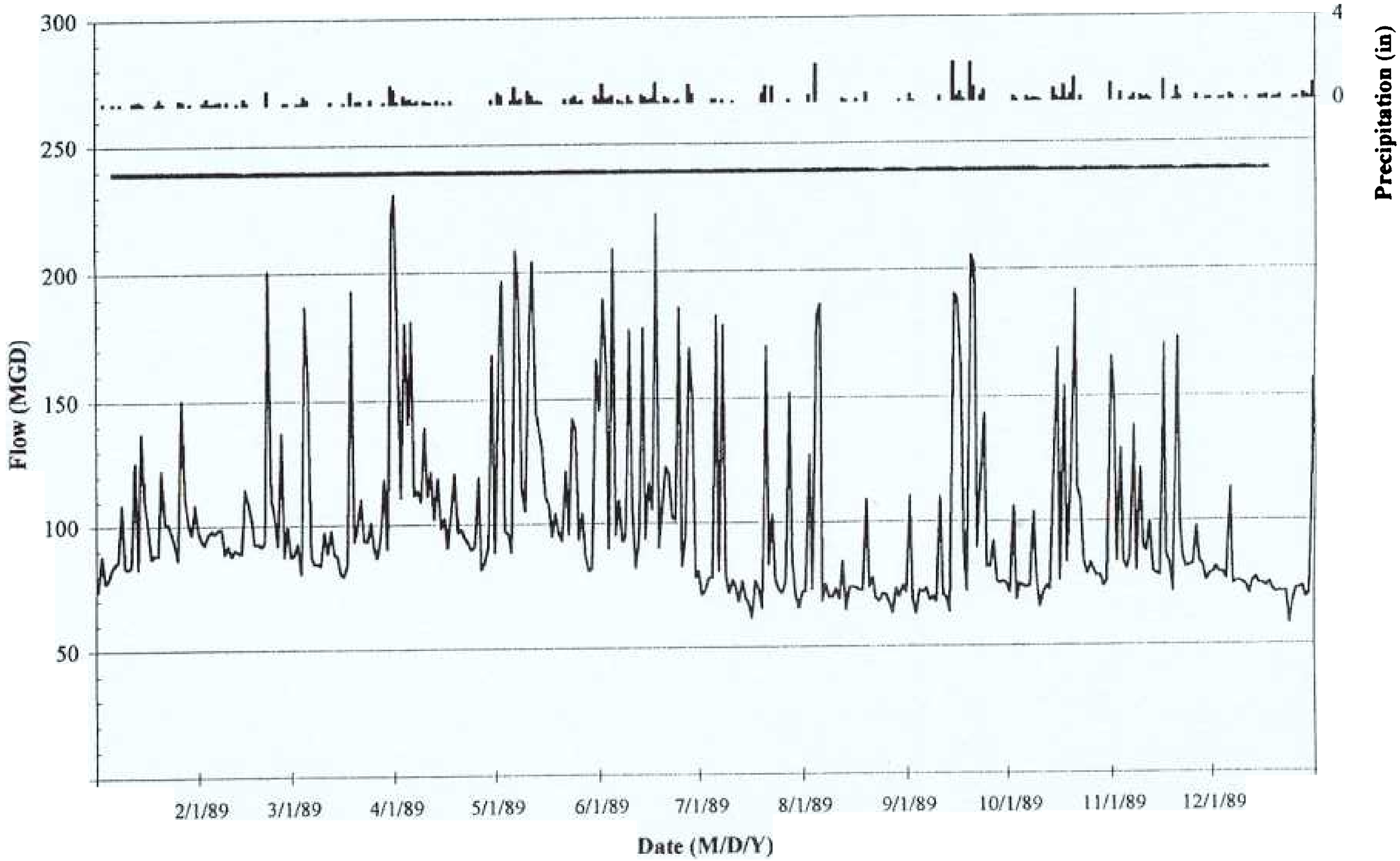
Daily Peak Flows at METRO 1987



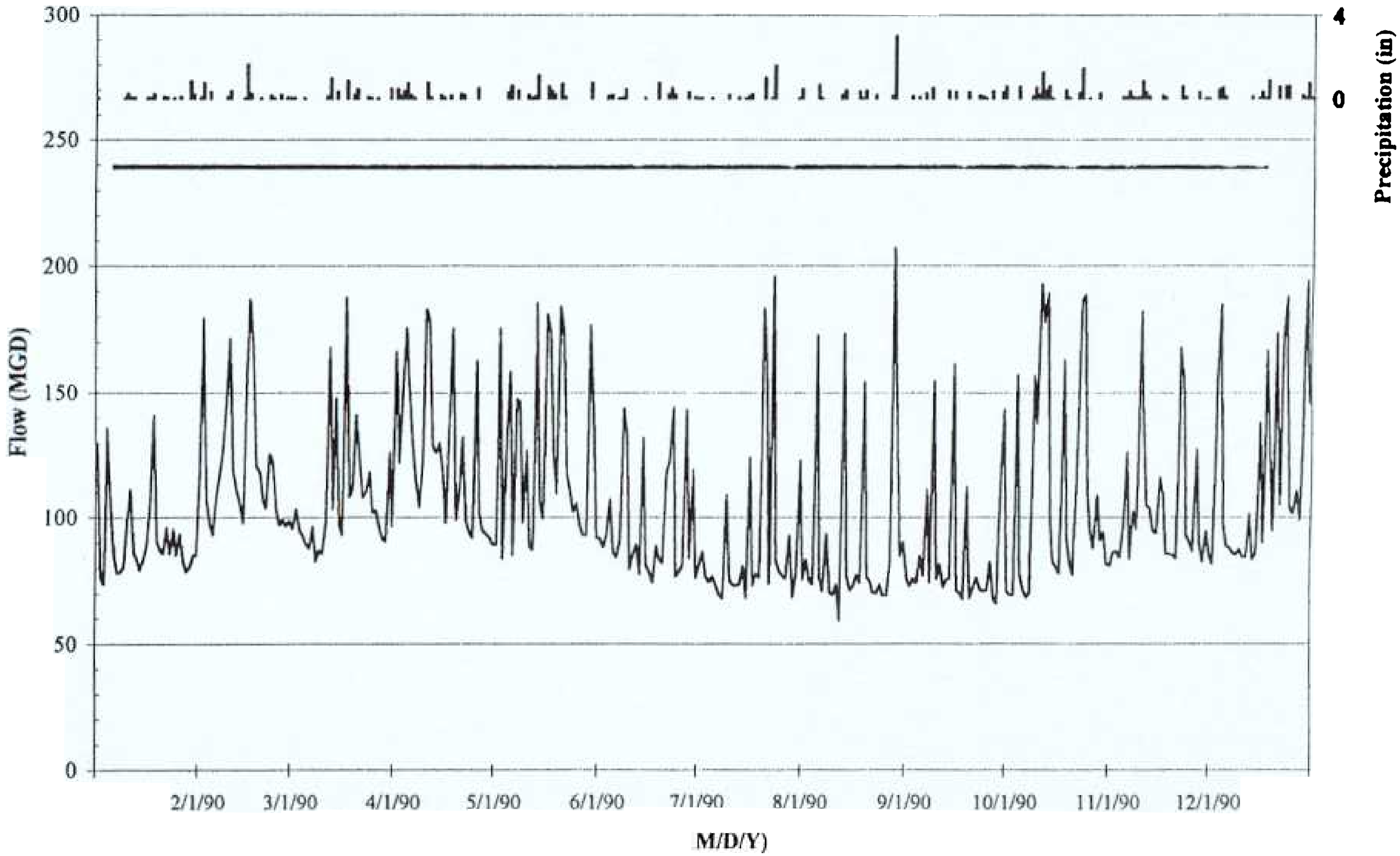
Daily Peak Flows at METRO - 1988



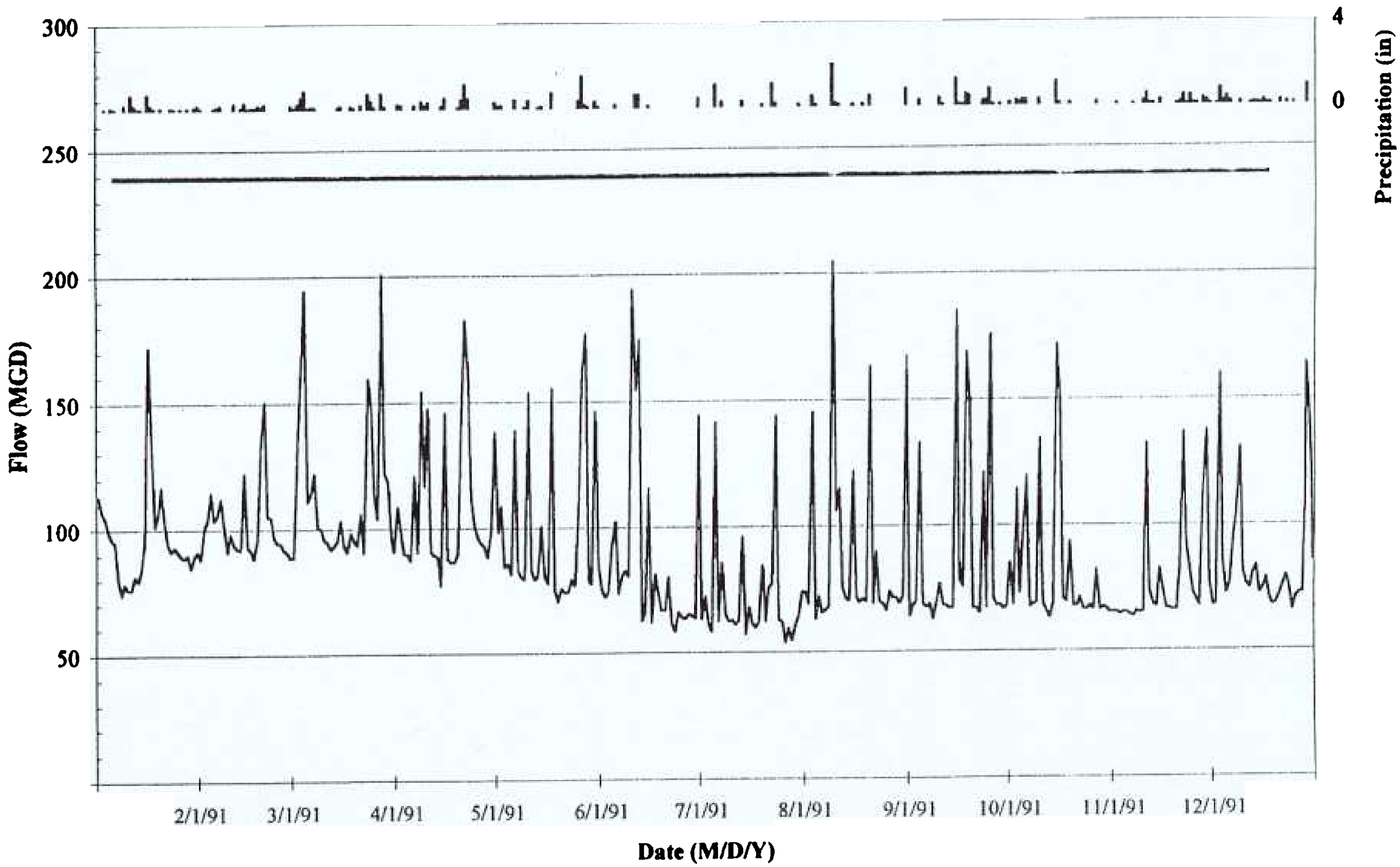
Daily Peak Flows at METRO - 1989



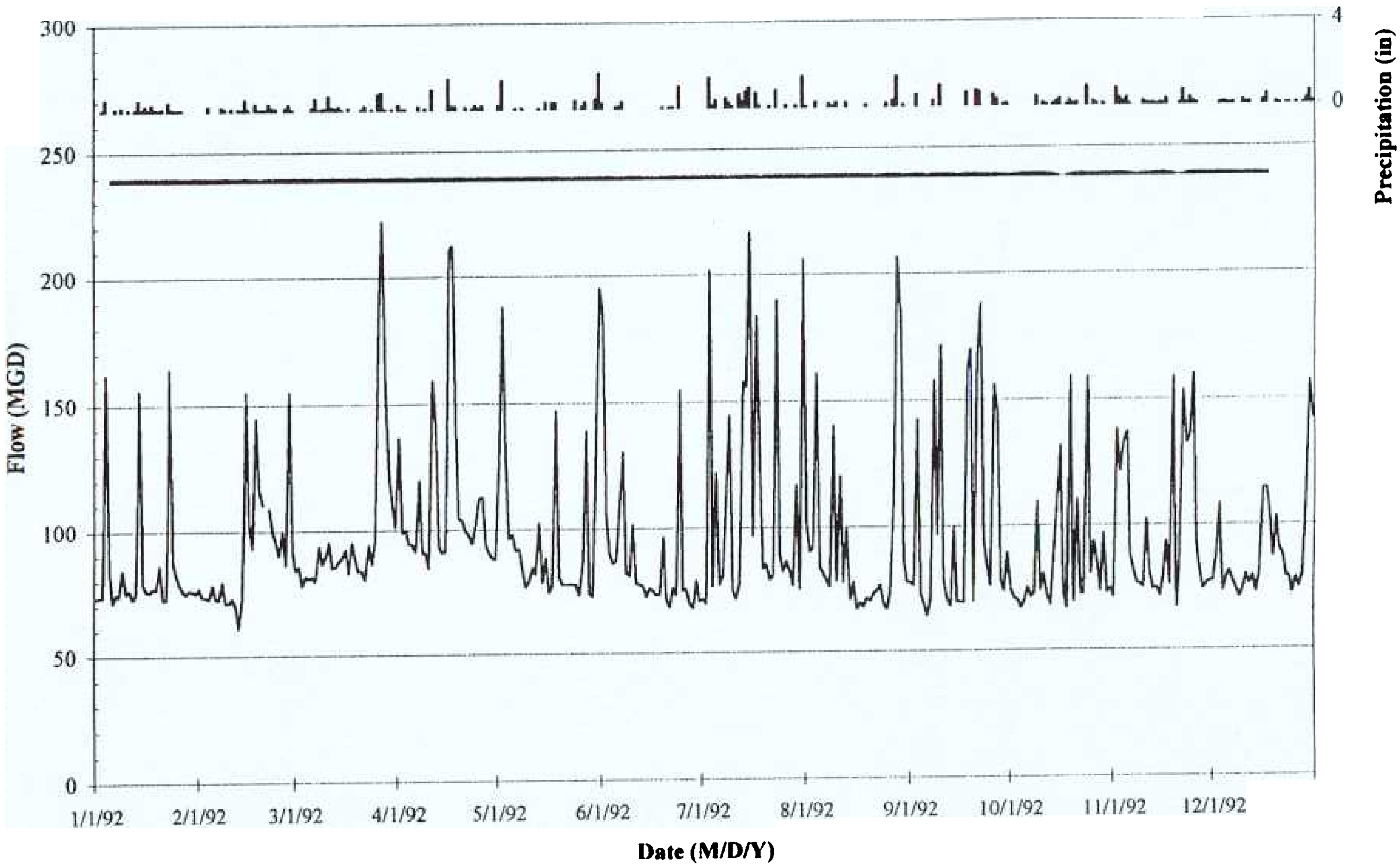
Daily Peak Flows at METRO - 1990



Daily Peak Flows at METRO - 1991



Daily Peak Flows at METRO 1992



APPENDIX D

EVALUATION OF THE SPENCER STREET BYPASS

CDM/C&S
Camp Dresser & McKee/C&S Engineers, Inc.
A Jo nt Venture

MEMO

MEMO TO: Michael J. Cunningham

FROM: Robert M. Palladine, Jr., P.E.

RE: **Evaluation of the Spencer Street Bypass**

FILE: 125.307.002

DATE: July 6, 2000

The Kirkpatrick Street Pump Station Upgrade project is proposed to convey an additional maximum 28 cfs (18.1 MGD) of wet weather flow to the Metro Headworks based on the 30% Engineering Design Report. During development of the 30% report, the County requested EEA and Moffa Associates to confirm the ability of the Headworks to accept the new flow and to determine the best location for discharge.

As part of the Headworks analysis, an investigation of the maximum influent flows from all sources was undertaken including: MIS, HBIS, Ley Creek PS, West Side PS, and Liverpool PS. Based on this investigation and analysis, it was determined that the MIS influent capacity at the New Screening and Grit (NSG) Building was limited to approximately 150 MGD. However, it was also noted that a flow restriction existed at the Onondaga Creek twin siphon crossing just below the Spencer Street Bypass. It was estimated that the MIS capacity at this location is limited to approximately 120 MGD.

Documentation of the hydraulic restriction occurring at the twin siphons led to an evaluation of upstream surcharge conditions in the MIS and the need to evaluate the potential for combined sewer overflows to occur at the Spencer Street Bypass. Based on recent modeling of the siphons and monitoring of the Spencer Street Bypass, it has been predicted that the Spencer Street Bypass will overflow an estimated 9 times per year on average. Previous to this time, it was thought that the Bypass only discharged rarely under very extreme conditions.

The Bypass structure is necessary to accommodate catastrophic shutdown of the Metro facilities. The structure is a gate which is opened from the bottom. The top of the gate structure acts as an open weir set at an elevation equal to the top of the MIS. However, under higher rainfall intensity conditions, the MIS will surcharge such that the flow gradeline is raised above the weir elevation. Abatement of the overflow is possible, and several scenarios have been considered.

Administrative Offices 1099 Airport Boulevard, North Syracuse, New York 13212 • Tel: 315 455-2000 • Fax: 315 455-9467
6661 Kirkville Road, East Syracuse, New York 13057 • Tel: 315 431-9997• Fax: 315 431-9929

The following summarizes the investigations and analyses associated with the Spencer Street Bypass. Attached is the detailed technical memorandum from Moffa and Associates dealing specifically with the MIS and Spencer Street Bypass.

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SYSTEM DESCRIPTION

The downstream section of the Main Interceptor Sewer (MIS) conveys flows to Metro through a 90 inch diameter pipe, crossing Onondaga Creek through twin 48 inch siphons, 100 feet in length. Approximately 300 feet upstream of the siphons is the Spencer Street Bypass structure which was originally installed to provide bypass of flows to Metro in the event of an emergency situation at the plant. Although the Bypass is designed to open from the bottom of the structure via a sluice gate, the top of the gate is open and can allow the MIS to overflow to Onondaga Creek during certain high flow conditions. In our opinion, the Bypass could be considered a CSO under Federal policy as it is consistent with the definitions contained in 40 CFR Part 122 and since greater than 80% of the tributary area is combined sewer.

INITIAL EVALUATION

In order to document the potential for overflows to occur at the Spencer Street Bypass, M&A was requested to provide input on the following items:

- Verification of headloss across the siphons;
- Capacity of the MIS under wet weather conditions; and
- Magnitude, frequency, and volume of potential bypass overflow occurrences and the associated rainfall conditions which could cause activation.

In response to the above request, the following information was developed:

Headloss Across Siphons

Based on level monitors placed at the Spencer Street Bypass and downstream manholes, the maximum measured water surface elevations were determined during an April 4, 2000 storm, which surcharged the Bypass. These hydraulic conditions represent the approximate maximum driving head conditions for the siphons. During this event, the difference in head was measured as 1.2 feet.

M
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Capacity of the MIS

The Hazen-Williams equation was used to estimate flow rates in the siphons. Using the observed headloss of 1.2 feet and an assumed "C" value of 120, the maximum hydraulic capacity of the siphons is estimated to be 120 MGD±. Lower "C" values result in higher head losses and correspondingly lower calculated flow capacity.

Frequency, Magnitude and Volume of Potential Bypass Overflows

M&A utilized the SWMM Model to identify the frequency and magnitude of overflows which could be predicted to occur at the Spencer Street Bypass. The model has recently been modified to include the latest information on hydraulic conditions downstream of the Bypass. Data supplied by the County for several storms during the period of April 4 through June 13, 2000 were used as input to the model for validation purposes.

The model and measured data indicate that the Bypass becomes active for rainfall intensities equal to or greater than approximately 0.30 inches per hour, depending on system conditions. An analysis of 30 year of rainfall records identified the frequency of events exceeding the 0.30 inch/hour intensity to be approximately 9.1 times per year on average.

The detailed SWMM model (EXTRAN) was also utilized to determine the frequency of discharge to better define the occurrence of overflows at Spencer Street. The results were consistent with the long-term rainfall data records analysis and are summarized below. Maltbie Street data are shown for comparison.

	Spencer Street Bypass	Maltbie Street FCF
Estimated Number of Overflows Per Year	9	48
Peak Overflow Rate	10.0 MGD (15.5 cfs)	56 MGD (86.6 cfs) (one year Storm)
Total Annual Overflow Volume	1.2 MG	21.3 MG
Average Overflow Volume Per Event	0.13 MG	0.44 MG

DESIGN STORM EVALUATIONS

Following the above initial evaluation, M&A was requested to evaluate the impact of various design storms for the existing condition at the Bypass as well as with the weir raised and with the Bypass closed. Based on the SWMM model results, the one year storm would activate the Bypass overflow with a peak discharge flow rate of 11 mgd (17 cfs). Various weir elevations were then simulated to estimate the elevation at which the one year storm would not overflow. The results of the SWMM model conservatively demonstrated that an increase in weir elevation of 15 inches would eliminate overflows up to the one year storm. The actual elevation required may be less due to the conservative assumptions used in these analyses.

Under this scenario, the discharge flow rate of 11 mgd (17 cfs) that would have occurred at Spencer Street under current conditions was predicted to be distributed as follows:

FLOW RATE	DISCHARGE	PERCENT OF DESIGN FLOW
4 MGD (6.2 cfs)	MIS to Metro	NA
1 MGD (1.5 cfs)	Maltbie FCF – CSO 066	2%
2 MGD (3.1 cfs)	Franklin FCF – CSO 020	1%
4 MGD (6.2 cfs)	Franklin FCF – CSO 021	2%
11 MGD (17 cfs)		

The analysis further showed that although a slight increase in treated flow would occur at these CSO locations, no increase in the frequency of discharges is expected, and the flow is captured for treatment.

Closing of the Bypass would create a similar situation for the one year storm, but would create a greater risk of flooding problems during higher rainfall intensity conditions. Local sewers upstream of the existing Bypass would be adversely impacted during intense rainfall conditions if the Bypass were completely closed. Due to the existence of older structures within the vicinity, additional field investigations would be required to document potential flooding problems.

RECOMMENDATIONS

In order to address the occurrence of overflows at the Spencer Street Bypass, consistent with the requirements of the ACJ, it is recommended that the weir elevation at the Bypass structure be raised to capture the one year storm. This could be done with minimal construction cost. Modeling data indicate that this can be achieved by raising the weir a total of 15 inches. The actual elevation required to capture the one year storm and avoid adverse impacts on local sewers may be less. Additional engineering will be required to design this modification.

Increased weir elevation at the Spencer Street Bypass is an implementable abatement option with good short-term applicability and long term potential. This alternative should be further developed, including engineering plans to construct the modifications. It is recommended that this include plans to incrementally adjust the weir elevation to minimize adverse system impacts. Monitoring should continue prior to and following the weir modifications to further document system operation, confirm that the Bypass overflow is eliminated up to the one year storm and document impacts on the upstream sewers. Upon review of these recommendations by the County, a schedule of implementation can be developed.

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cc: Dick Elander
Steve Martin
Sue Miller
Bob Kukenberger

M:\ONONDAGA.CTY\SPENCER STREET BYPASS.JUNE 20

MEMORANDUM

To: Bob Palladine

CC:

From: Daniel P. Davis, P.E.
Howard M. Goebel, P.E.
Scott Braymer, P.E.

Date: 7/6/00

RE: MIS Siphon Calibration & Evaluation of Spencer St. Bypass

File: 154.01

Background

The Main Interceptor Sewer (MIS) conveys flow to METRO during dry and wet-weather flow conditions. The downstream sections of the MIS are approximately 90 inches in diameter. The MIS crosses Onondaga Creek via double barrel inverted siphons approximately 4,400 feet upstream of METRO. The siphons are 48-inch sewers approximately 100 feet in length. A short distance (approximately 300 ft.) upstream of these siphons is the Spencer Street Bypass structure. The Bypass was originally installed to provide relief of flow from the MIS to METRO in the event of emergency conditions. The Bypass is designed to open from the bottom of its structure via a sluice gate; however, the top of the gate is open and allows the MIS to overflow to Onondaga Creek during more intense rainfall conditions. The top of the Bypass acts as a 10-foot long weir during surcharge conditions. Figure 1 depicts the layout of the Bypass structure. The Bypass could be considered a CSO since greater than 80% of the tributary area (5200 acres) is combined.

The bypass weir elevation is set at an elevation to cause full pipe flow in the MIS before it can overflow to Onondaga Creek. The elevation of the bypass has been measured at approximately 0.4 feet above the crown of the MIS, which is also approximately 90 inches in diameter downstream of the Bypass. Recent evaluations to determine maximum flow capacity at METRO have raised several concerns, namely:

- Verification of the headloss of the hydraulically restrictive siphons using upstream and downstream level monitoring equipment.

  Establishing the capacity of the MIS to convey wet-weather flow to METRO
- Establishing the rainfall conditions that cause the Bypass to activate
- Identifying the current average annual Bypass discharge volume.
- Identifying the magnitude and frequency of Bypass occurrences.
- Developing alternatives for reducing and/or eliminating flow from the bypass

The purpose of this memo is to address these concerns based on the recent monitoring and modeling that have been conducted. The most recent storm measured on June 13, 2000 has been critical to calibrating/validating this hydraulic component of the SWMM. The higher rainfall intensities associated with this storm was important in validating the model's projections of depth in the MIS.

Headloss verification across Siphons and Determination of MIS capacity

The maximum capacity of the MIS downstream of the Spencer Street Bypass (including the twin 48-inch siphons) has been estimated to be approximately 120 MGD (185 cfs). The siphons, combined with the hydraulic head available to drive flow through the MIS restrict the flow that can be delivered to the METRO headworks through the MIS.
Level monitors were placed at the Spencer Street bypass and a manhole located downstream of the siphons to verify water surface levels in the MIS. Placement of the meters was difficult since the MIS is a large diameter sewer with constant flow. Therefore, the sensor elevations were established to the nearest several inches in elevation with respect to each other. This was considered acceptable for the purposes of identifying the required information. The maximum measured water surface elevation at the bypass was slightly over the crest of the overflow weir during the April 4, 2000 storm event. Additionally, verification was made by tell-tale monitoring of the overflow (displacement of wooden blocks set on the weir crest). These hydraulic conditions represent the approximate maximum driving head conditions for the siphons. During this event, the difference in head was measured as 1.2 feet. This is shown on Figure 2.

The Hazen Williams equation was used to estimate flow rate in the siphons. For the purposes of this evaluation, it was necessary to develop a set of assumptions to account for the measured head loss. A sensitivity analysis was performed for a range of flows and pipe roughness (Hazen William C-factor). Table 1 summarizes this sensitivity analysis. A "C" factor on the order of 120 is the highest that can be reasonably assumed for this sewer pipe (it is appropriate for "good" masonry aqueducts per the Hazen-Williams tables). Field investigations confirmed the "good" condition of the MIS. This analysis shows that a flow rate of 120 MGD (185 cfs) +/- is the maximum that can be passed through this reach using the observed head loss of 1.2 feet and an assumed C of 120. Lower C-values result in higher head losses and correspondingly lower capacities.

The flow monitoring and engineering calculations have confirmed the MIS capacity and resulting siphon-flow restrictions.

The model and measured data demonstrate that the Bypass becomes active for rainfall intensities at approximately 0.30 inches per hour, depending upon antecedent conditions.

Following the model validation described above, an analysis was performed on the rainfall record from 1957 through 1987 using hourly rainfall records The analysis identified the frequency of rainfall events that had a maximum rainfall intensity of 0.30 in/hr or greater. Over the 31-year period of record, it is estimated that this rainfall intensity is exceeded approximately 9.1 times per year, on average.

LONGTERM (CONTINUOUS) SIMULATION RESULTS

The detailed SWMM model (EXTRAN) was used in a continuous simulation mode to identify the frequency of discharges during a typical year to better define the frequency of overflows at the Spencer St. Bypass. The year 1991 was selected for this purpose since it has been previously used in projecting average annual conditions and since 1991 has been determined to represent average rainfall conditions. It is important to note that this modeling strategy of using the EXTRAN block of SWMM is not typically used since it requires significant processor time and large disk space. Recent advances in computers have allowed these simulations to be conducted. The model simulations are summarized below and are consistent with the evaluation of long-term rainfall data records for Syracuse. For the purposes of comparison, the relative magnitude and volume of overflow is also shown for the Maltbie St. FCF which is the smallest of the planned CSO facilities. Figure 8 depicts the results of the long-term projections at the Spencer Street Bypass for the year 1991.

	Spencer St. Bypass	Maltbie St. FCF
Number of overflows per year	9	48
Peak overflow rate	10 MGD (15.5 cfs)	56 MGD (86.6 cfs) (1-yr storm)
Total annual overflow volume	1.2 MG	21.3 MG
Average overflow volume per event	0.13 MG	0.44 MG

The model was also used in a continuous simulation mode to evaluate the impact of raising the weir elevation until no overflow resulted. The model showed that overflow could have been eliminated during the 1991 period by raising the weir 15 inches.

Design Storm Evaluations

The SWMM model was also used to evaluate the results of the 1-year design storm for the existing conditions at the Bypass as well as with the Bypass closed. In addition, the model was used to identify the maximum water surface elevation in the MIS under these conditions. It is interesting to note that the existing 1-year design storm overflow rate at the Bypass is similar to the maximum discharge predicted during the 1991 period discussed above (11 MGD versus 10 MGD or 17 cfs versus 15.5 cfs).

The results of simulating the 1-year storm demonstrate the Bypass activates with a peak flow rate of 11 MGD (17 cfs) under the existing conditions. The model results demonstrate that in order to eliminate overflow up to the 1-year storm it will be necessary to raise the weir elevation 15 inches (1.25 ft.). The raised weir elevation caused flow to increase in the MIS downstream of the Bypass by 4 MGD (6.2 cfs); the remaining 7 MGD (11 - 4 = 7) would be discharged upstream at the Maltbie St FCF Overflow (CSO 066) and the Franklin St. FCF Overflows (020 and 021). The increased hydraulic grade line in the Interceptor causes these discharges. It is important to note that these locations currently receive treatment of CSO via netting-type facilities. The additional flow is estimated to be as follows during the 1-year storm:

Location	Increased Flow Rate Resulting from Raising Weir at Bypass	% of Design flow at FCF
Maltbie St. FCF -CSO 066	1 MGD (1.5 cfs)	2%
Franklin St. FCF - CSO 020	2 MGD (3.1 cfs)	1%
Franklin St. FCF - CSO 021	4 MGD (6.2 cfs)	2%

Additional evaluations were conducted to identify the impact associated with the 10-year storm with the Bypass closed completely. The results of this evaluation demonstrate the MIS surcharges at the current Bypass location to approximately 2.25 feet above the existing weir elevation (approximately 1.7 feet from the manhole rim). The water surface in the manhole upstream of the Bypass is less than 0.5 feet from flooding the manhole rim. The upstream manhole is located on the opposite side of the creek from the Maltbie St. FCF and is the location where the Maltbie St. siphon connects to the MIS. The manhole is located on the Creek side of the Unity Life building along the walk path. Figure 9 depicts the hydraulic grade line for the MIS in the vicinity of the Bypass for this condition. **Local sewers upstream of the existing Bypass would be adversely affected during intense rainfall conditions if the Bypass were completely closed.**

The increased weir elevation appears to be the most appropriate action based on a number of factors, including:

Achieves the ACJ requirements

- Ease of construction
- Lack of operation and maintenance required
- Low cost

Conclusions

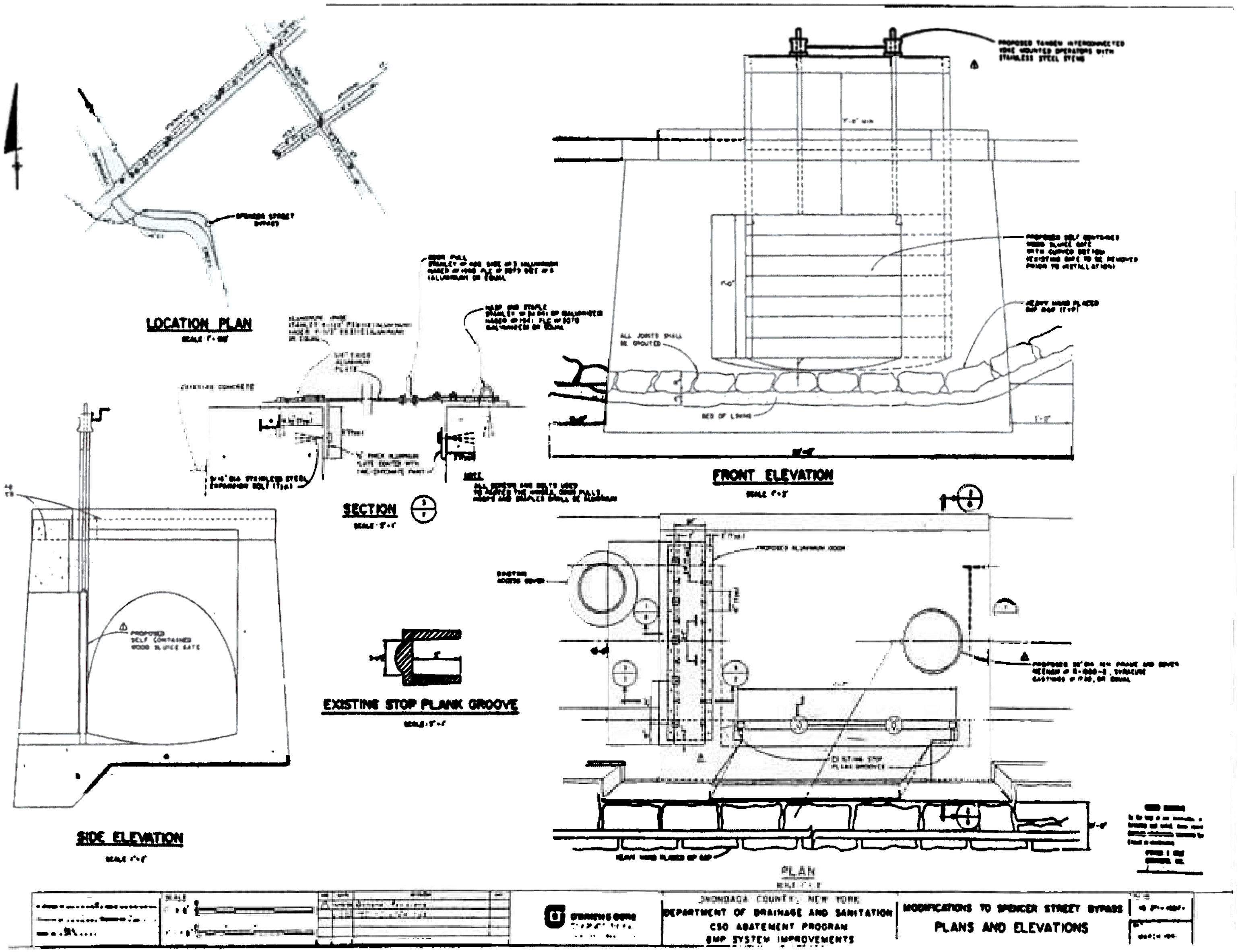
The results of these analyses are summarized below:

- The capacity of the MIS siphons (lower crossing) and their associated headloss has been validated with level measurements. The MIS full pipe capacity at the siphon location is approximately 120 MGD (185 cfs).
- Model calibrations were previously performed at CSO locations (1987) throughout the collection system. Recent monitoring within the Main Interceptor Sewer has validated the model's ability to predict flows not only in the CSOs but also within the Interceptor. The current model is well calibrated for larger rainfall conditions and for smaller events, which are important in long-term projections for the 85% volume capture.
- The SWMM was used to predict the frequency and magnitude of overflow at the bypass using 1991 as an average rainfall year. The results were consistent with analysis of the long-term rainfall records. According to the model, the Bypass would activate relatively infrequently (approximately 9 times per year, on average) as compared with other CSOs within the collections system (approximately 50 times per year). Evaluations included a determination of the elevation at which the Bypass weir could be raised to eliminate the overflow during the 1991 period. A 15-inch increase in weir elevation was sufficient to eliminate overflows.
- The SWMM was used to evaluate existing and raised weir conditions at the Bypass for the 1-year and 10-year design storms. Overflows could be eliminated up to the 1-year design storm by raising the weir 15 inches. **If the Bypass were closed completely, significant surcharge will result under higher intensity rainfall conditions (greater than 1-year) that may adversely affect local sewers and those connected to these sewers.** Figure 10 shows the area that will be affected.

Recommendations

- It is recommended to increase the weir elevation at the Bypass location to eliminate discharges up to the 1-year design storm. This would be consistent with the projects named in the ACJ and their design conditions. The increased weir elevation alternative as identified above could be installed in a very short period of time. Additional engineering will be required to identify how modifications can be made to the existing structure.

  It is important to note that monitoring should continue during and following weir modifications to confirm the Bypass overflow can be eliminated up to a one-year storm. Incremental increases in weir elevation are advisable (such as 4 – 6 inches) to minimize surcharge within the Interceptor so as not to adversely affect local sewers.



LOCATION PLAN
SECTION
FRONT ELEVATION
SIDE ELEVATION
EXISTING STOP PLANK GROOVE
PLAN
ALL JOINTS SHALL BE GROUTED
PROPOSED SELF CONTAINED WOOD SLUICE GATE
ONONDAGA COUNTY, NEW YORK
DEPARTMENT OF DRAINAGE AND SANITATION
CSO ABATEMENT PROGRAM
BMP SYSTEM IMPROVEMENTS
MODIFICATIONS TO SPENCER STREET BYPASS
PLANS AND ELEVATIONS

Figure 1

Figure 2
SPENCER ST. SIPHON EVALUATION
Upstream and Downstream Hydraulic Grade Lines

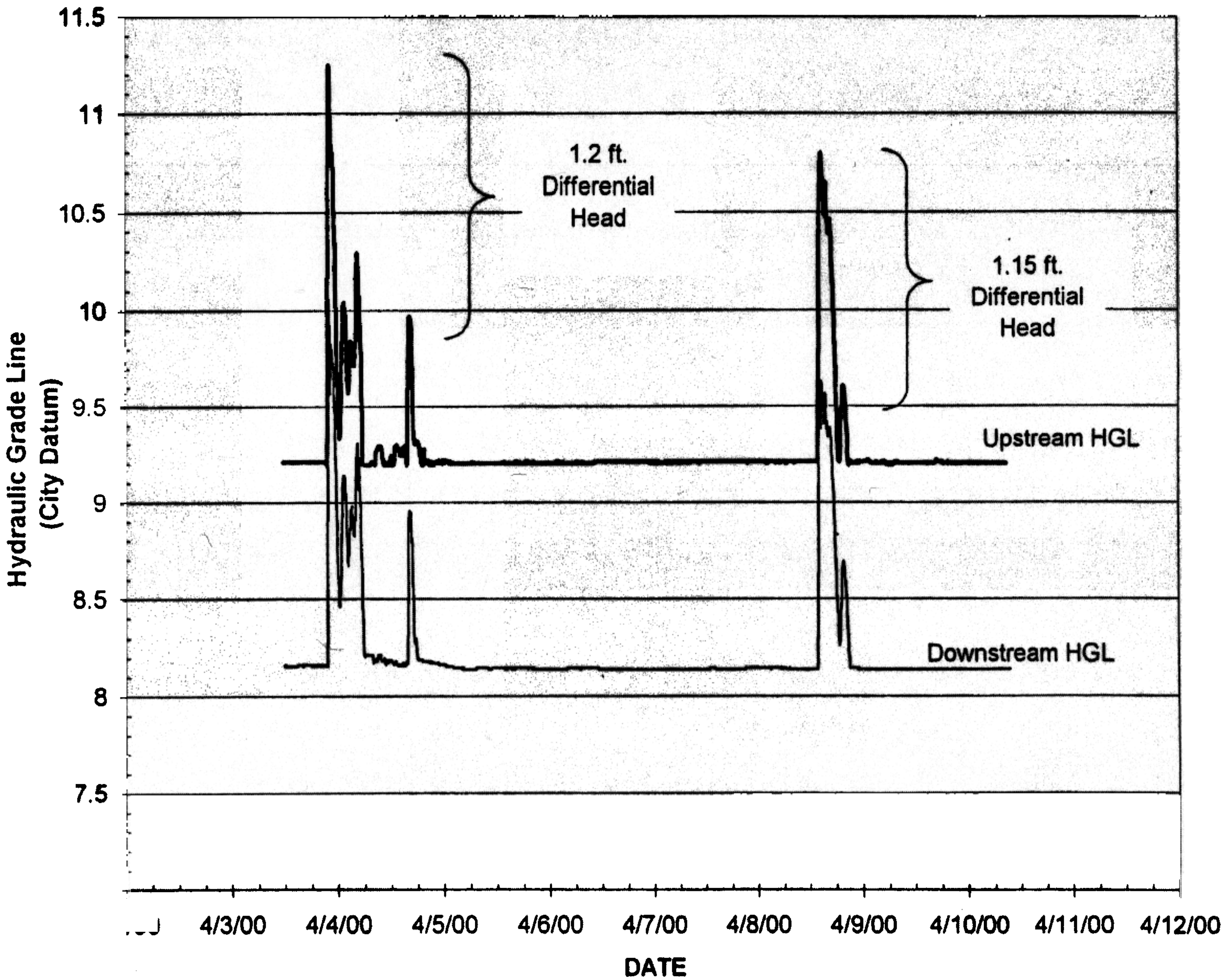


Figure 3
Water Surface Level at Spencer St Overflow
April 3- 4, 2000

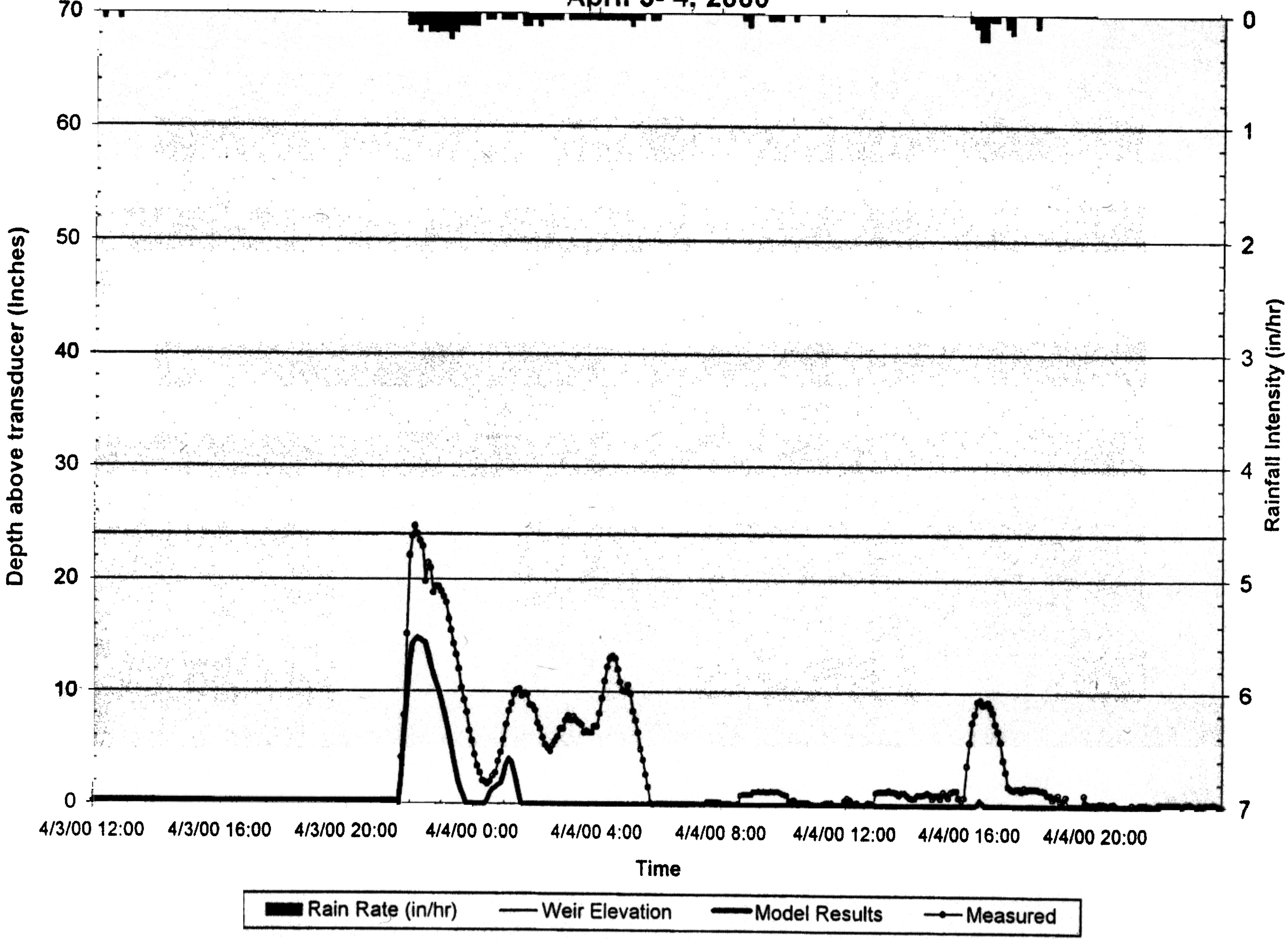


Figure 4
Water Surface Level at Spencer St Overflow
April 8, 2000

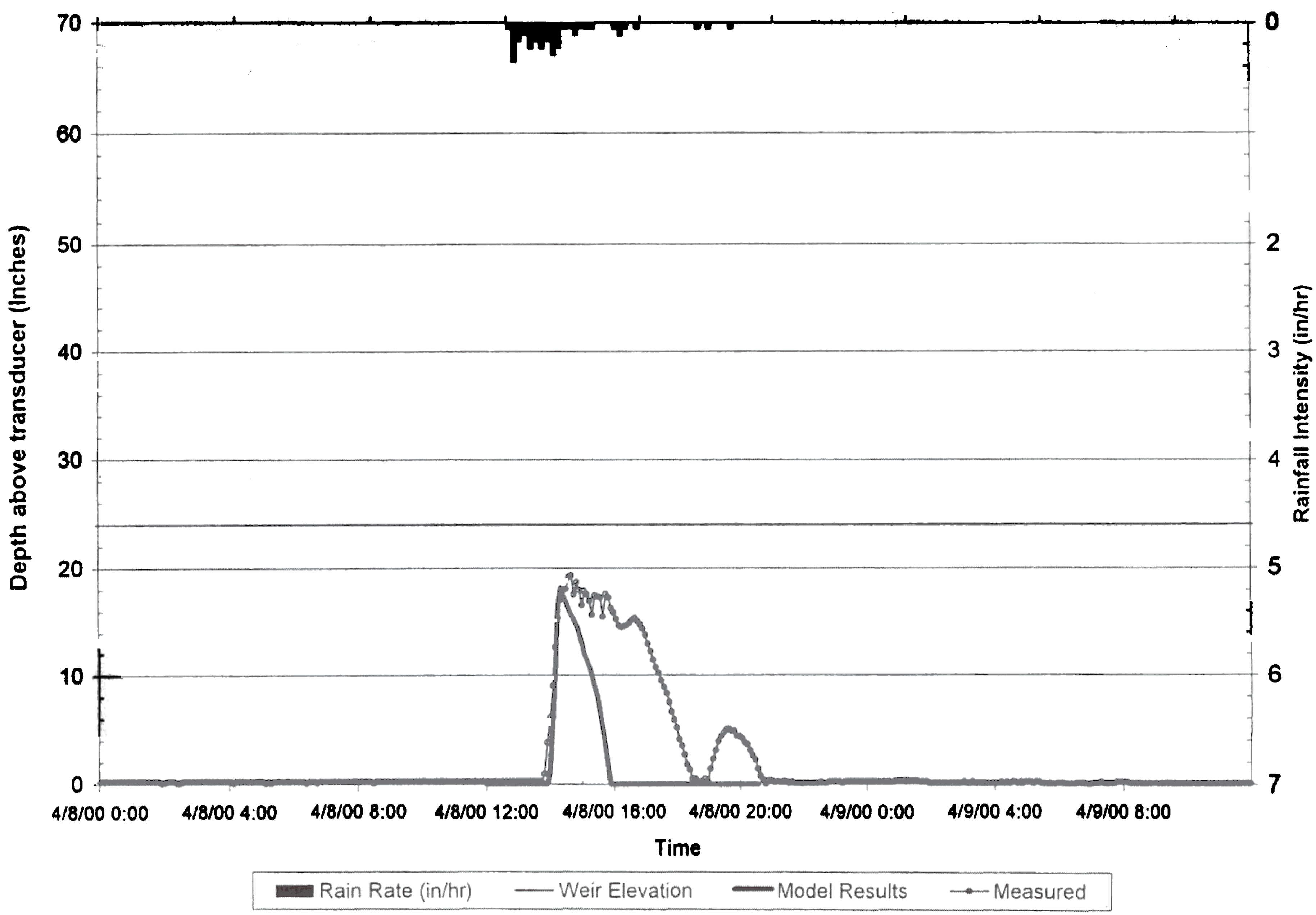


Figure 5
Water Surface Level at Spencer St Overflow
May 13, 2000

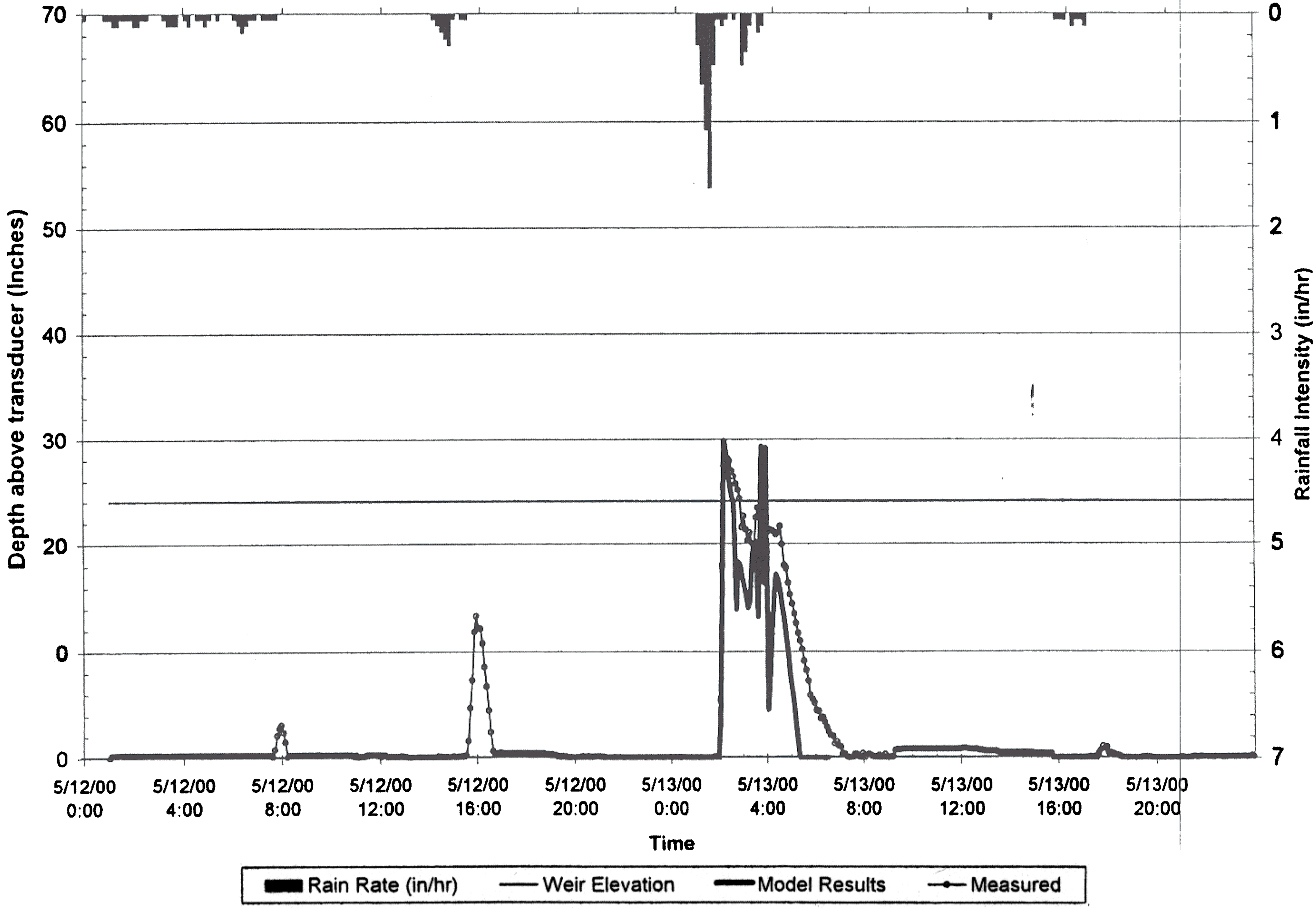


Figure 6
Water Surface Level at Spencer St Overflow
May 18, 2000

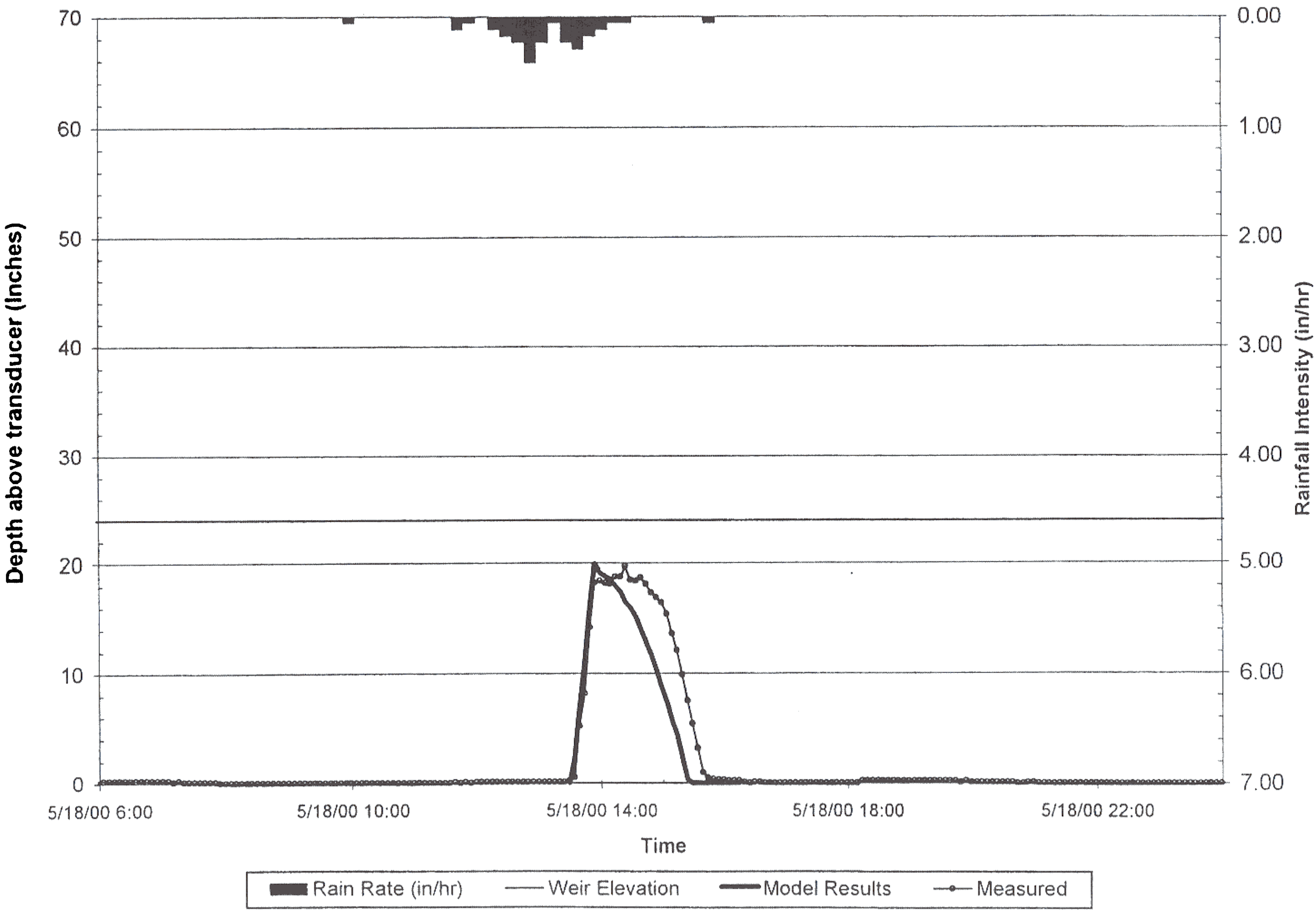


Figure 7
Water Surface Level at Spencer St Overflow
June 13, 2000

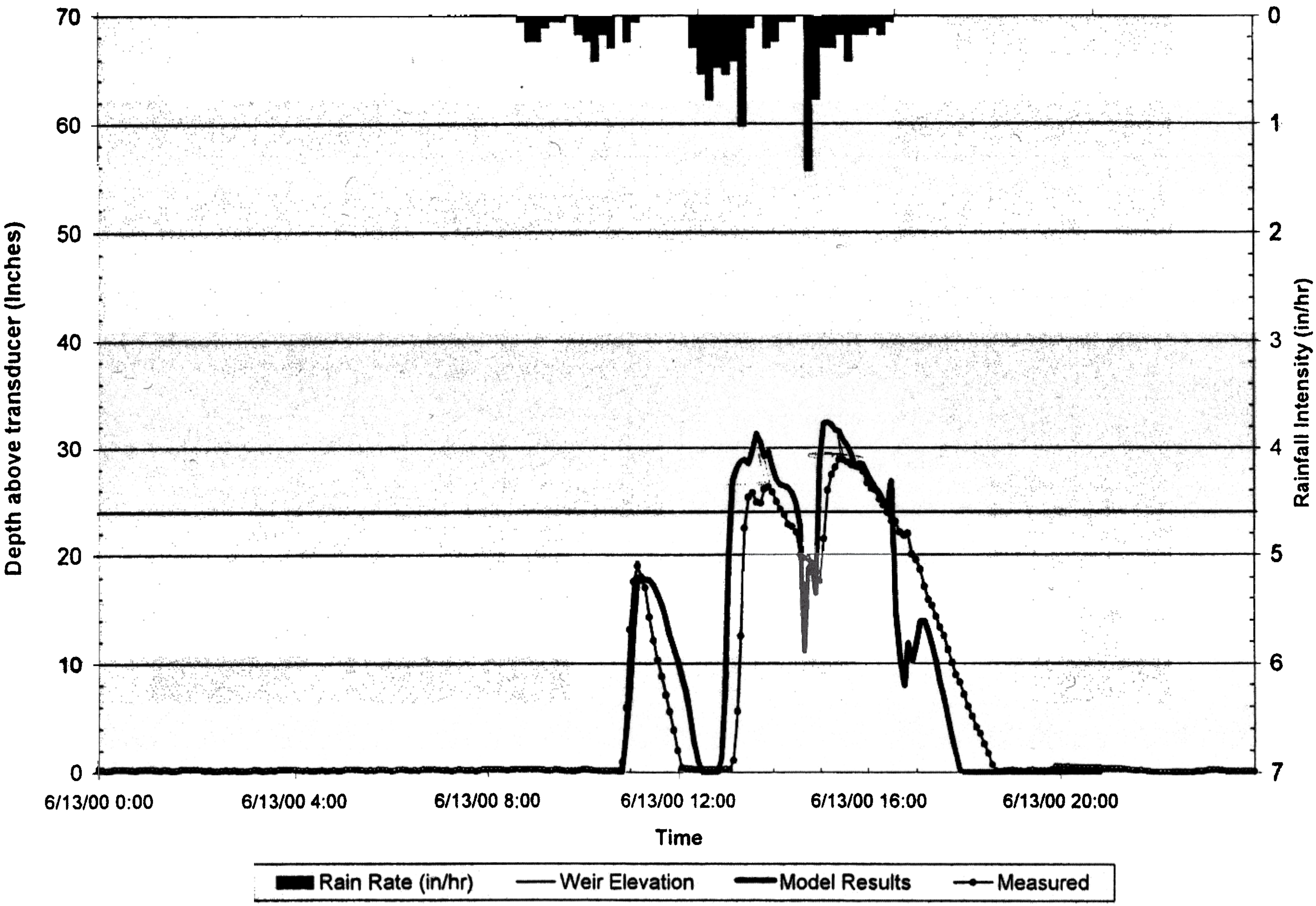
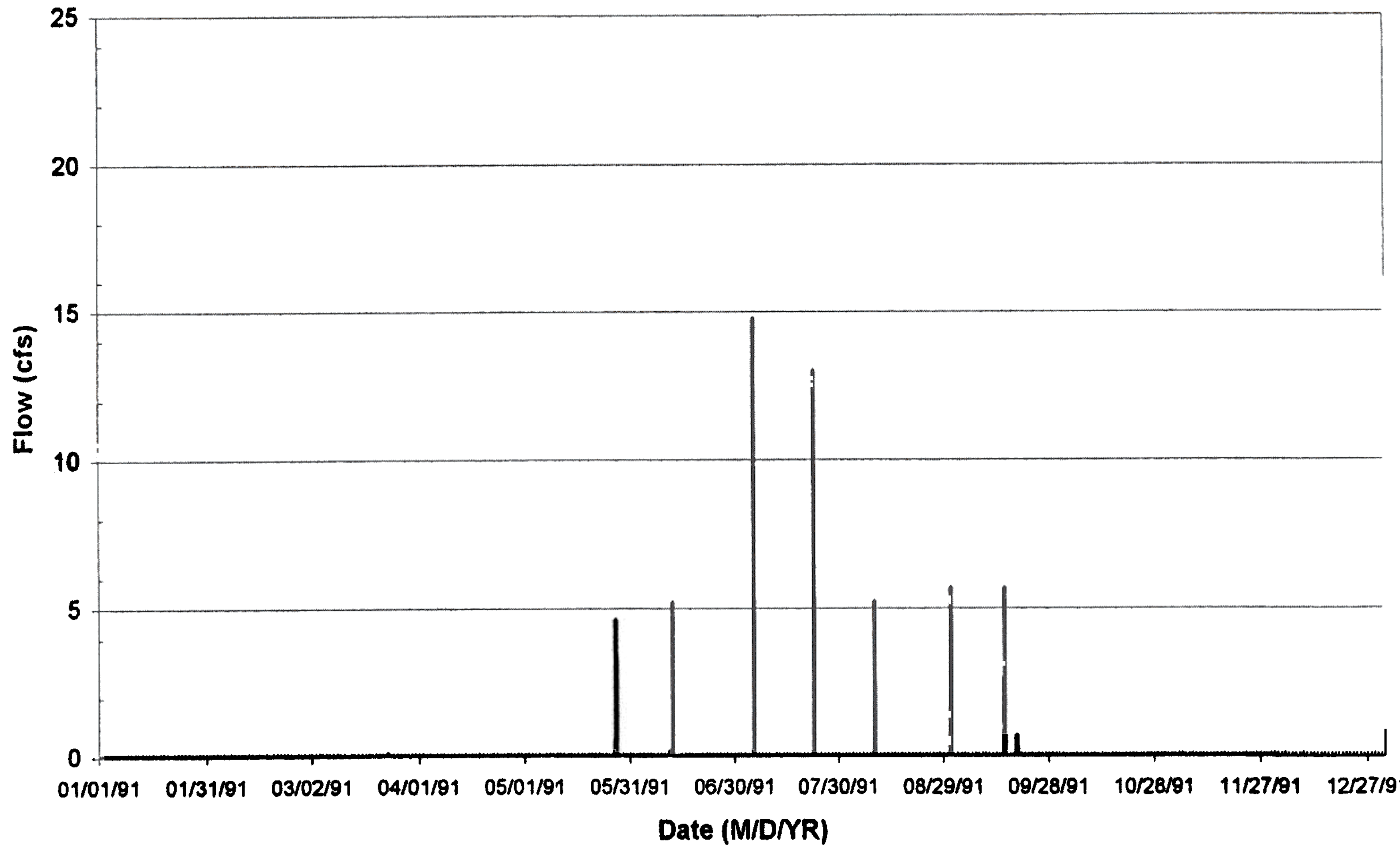
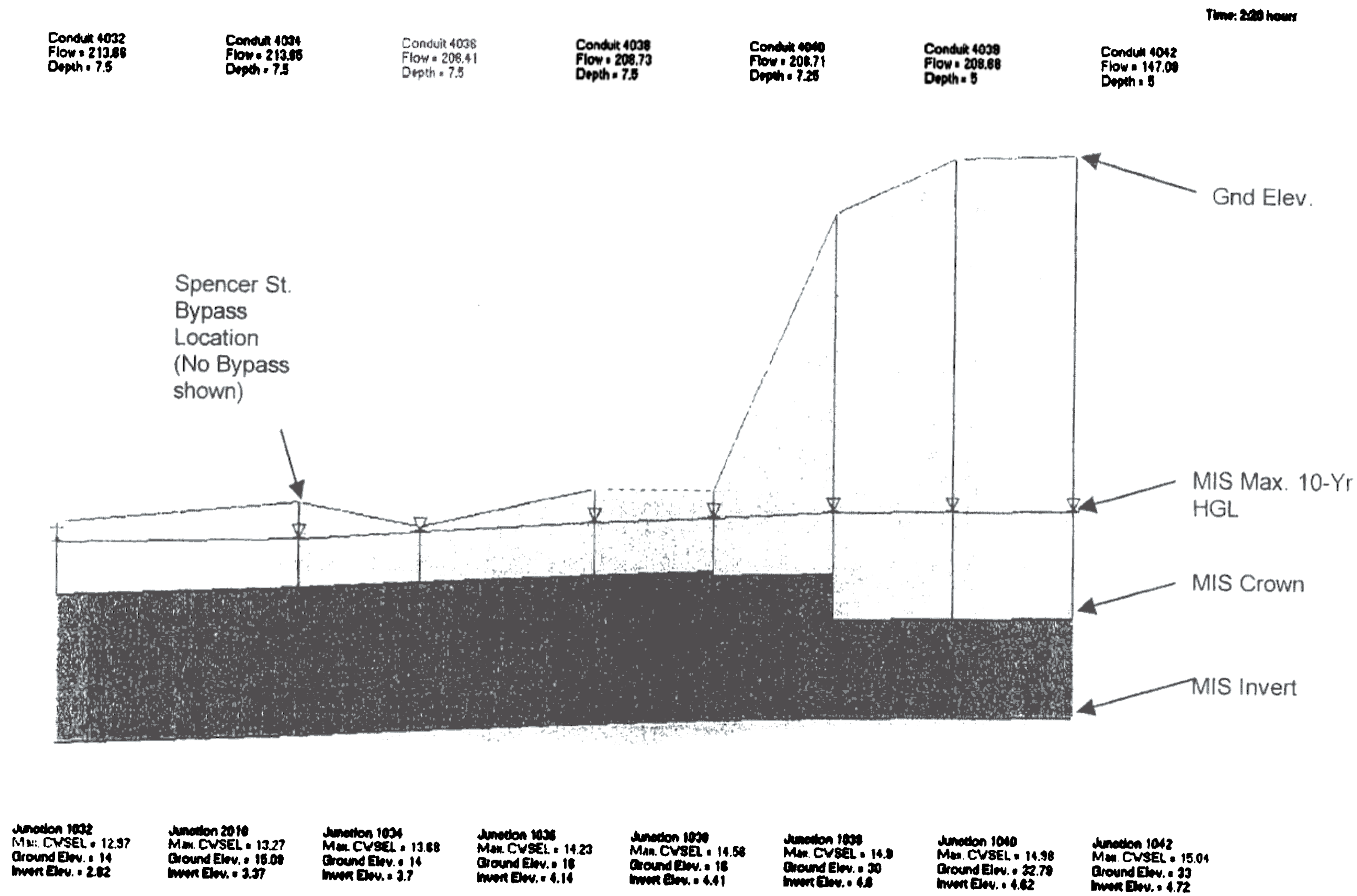


Figure 8
Spencer Street Bypass Overflow Hydrograph
Predicted for 1991



Developed using SWMM EXTRAN

Figure 9
Main Interceptor Sewer Hydraulic Profile
10-Year Design Storm
Spencer St. Bypass Closed



MOFFA & ASSOCIATES

MOFFA & ASSOCIATES
CONSULTING ENGINEERS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
AREA INFLUENCED BY RAISING BYPASS WEIR	154.01	DRD	6/22/00	

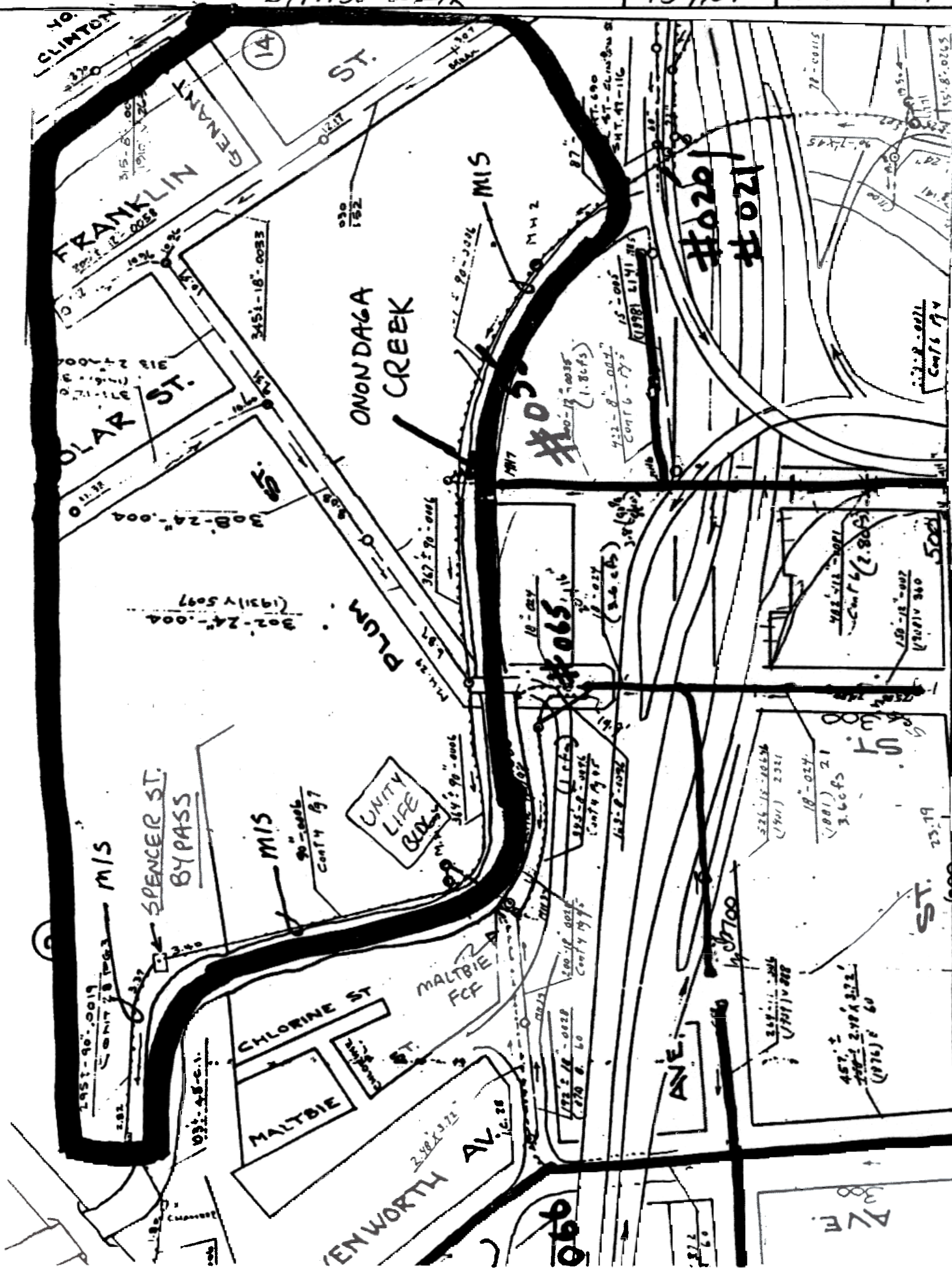


Figure 10

APPENDIX E

MEMORANDUM-HYDROLOGIC AND HYDRAULIC MODEL TECHNICAL REVIEW

Camp Dresser & McKee

MEMORANDUM

To: Robert Kukenberger

From: James Smullen
Edward Burgess
Michael Clement

Date: July 12, 2000

Project: Onondaga Lake Improvement Project – Hydrologic and Hydraulic Model Technical Review

Subject: Results and Recommendations

A Technical Review Committee was formed to review the Onondaga County combined sewer overflow (CSO) model development, calibration and utilization. The Technical Review Committee (TRC) make up included three members: James Smullen from the CDM-Edison, New Jersey office; Edward Burgess from the CDM-Cincinnati, Ohio office; and Michael Clement of the CDM-Philadelphia, Pennsylvania office.

The TRC was tasked with reviewing the Onondaga County USEPA Stormwater Management Model (SWMM) development, calibration and utilization. TRC objectives focused on review of the modeling approach and process (formulation, assumptions, and application) to evaluate model adequacy in supporting the Onondaga County CSO program, but did not extend into detailed review of model datasets or output.

Two TRC meetings were held (April 4 and April 25, 2000) to review the hydrologic and hydraulic analyses performed in support of the Onondaga County Department of Drainage and Sanitation Lake Improvement Project. Present at the meetings were Steve Martin (OCDDS), Dan Davis (Moffa and Assoc.) and Howard Goebel (Moffa and Assoc). The philosophy of the TRC was discussed at the first meeting, including the reasons the members were selected and their intended roles. A written summary of the purpose and approach proposed for the TRC process and, resumes of the TRC members and other related materials was provided to County staff. The results of the review and the conclusions reached by the TRC are included herein.

<u>Background of CSO System</u>
During the review meetings, Moffa and Associates (M&A) staff presented an overview of the Onondaga County collection system tributary to the Metro Water Pollution Control Plant (Metro). Descriptions of tributary combined, stormwater and separate sanitary sewer systems were provided and the interaction of these systems was discussed to facilitate an understanding of the SWMM model development and model assumptions. Modifications to the collection system constructed in the 1980s as part of the County's Best Management Practices (BMP) Program also were discussed. Critical hydraulic elements in the collection system were reviewed including three separate sanitary pump stations discharging to the Metro WPCP, the Harbor Brook combined sewer system and lift station, and the Main Interceptor System (MIS).

The development of one-year design storm hydrographs to CSO regulators with proposed abatement facilities including remote treatment facilities and floatable controls was identified as the primary focus of the modeling studies. The application of the SWMM model for the system includes both single event-based and continuous simulation analyses. Hydrologic simulations were performed using the RUNOFF block. Collector system hydraulics were modeled using the full dynamic routing equation capabilities of the EXTRAN block for single event simulations and the link-node, kinematic routing capabilities of the TRANSPORT block for continuous simulations.

Model Development History
M&A staff presented a review of the SWMM models development history. Initial SWMM models were developed by O'Brien and Gere to support the County's 1979 Facility Plan. Later, M&A ported these models to a personal computer environment while refining and extending them to include SWMM/RUNOFF, EXTRAN and TRANSPORT models of the combined, stormwater and separate sanitary sewer system tributary to the Metro WPCP. The reasons for not including some combined and sanitary sewered areas in the current model were discussed, and the desirability of expanding the model to include several separate sanitary areas tributary to the upstream reaches of the MIS was identified. The potential impact(s) of the Spencer Street Bypass and MIS Lower Crossing siphon were discussed in detail to clarify initial model assumptions and verify if it is necessary to include these controls in the SWMM/EXTRAN and TRANSPORT models. Utilization of recently installed HGL sensors at the Lower Crossing siphon to verify bypass and siphon model elements also was discussed.

Hydrologic and Hydraulic Characterization
M&A staff provided an overview of the SWMM model's characterization of the Onondaga County collection system. Model representation of dry weather flows, critical hydraulic controls in the collection system and surface runoff flows were reviewed. The characterization of the collection system and the design of abatement facilities using continuous simulations and design storms also were discussed. Model calibration results were presented by M&A staff, and the potential utility of additional model vs. observed data comparisons were discussed (see below).

Modeled dry weather flows estimated based on Metro WPCP daily flow data and their area-weighted distribution in the collection systems were reviewed. The assumption of limited impact of baseflows on CSO abatement facility designs was presented by M&A staff. A description of the equivalent weirs and regulator control pipes modeled to represent leaping weir regulators was present by M&A staff. Model representation of the Erie Boulevard Storage System was discussed including model overflows and assumption of drain-down control and timing. The utilization of variable orifices to control the drain-down of Erie Blvd. storage was suggested to better represent the impact of MIS levels on drain-down times and storage utilization.

Model representations of pervious and impervious surface runoff using the SWMM/RUNOFF block and hourly precipitation data was discussed. M&A staff identified impervious cover as the dominating component of the one-year design storm hydrographs at sites selected for CSO abatement facilities. Model representation of Rainfall Dependant Inflow and Infiltration (RDII) in separate sanitary areas was reviewed, and model simulations demonstrated interceptor conveyances limiting separate sanitary RDII in the upstream reaches of the MIS system. Concerns were expressed regarding the ability of the model to represent rainfall-dependent infiltration and inflow and groundwater infiltration, specifically related to interflow prediction and post-storm hydrograph recession.

M&A provided a review of design storm and continuous simulations performed using EXTRAN and TRANSPORT models. The use of TRANSPORT for long-term simulations was validated through the verification of TRANSPORT datasets against EXTRAN datasets for similar wet weather events. However, the validity of this assumption and the details of the application have not yet been investigated by the TRC. CDM suggested the use of SWMM version 4.4(g) to performed continuous EXTRAN simulations with a revised model dataset incorporating the Spencer Street bypass, Lower Crossing siphon and all tributary separate sanitary areas to verify TRANSPORT continuous simulations, and better demonstrate expected inflows to and impacts of the proposed abatement facilities.

Model calibration documentation was presented by M&A staff. Locations, accuracy and availability of monitoring data utilized in the calibration and verification were discussed. The limited rain gage coverage - only two gages in the entire system - was identified as the most-probable component for model deviations from monitored flows. CDM suggested additional comparisons of model vs. monitor time series for the calibration time period, fall 1987, to better document model accuracy. CDM also suggested the acquisition of Metro hourly WPCP inflows to document model vs. monitored inflows to the WPCP from the MIS and Harbor Creek collection systems. Additional documentation methods were also discussed, and CDM agreed to submit examples of alternative documentation methods to M&A staff. Documentation of continuous Simulation calibrations should include plots of observed versus simulated cumulative distributions.

Abatement Planning Results

CDM and M&A staff reviewed the CSO percent capture calculations. A revised method was suggested using model-estimated regulator pipe and outfall pipe flows from continuous TRANSPORT simulations. M&A staff displayed EXTRAN simulations of the proposed system for the 90th percentile 4–hour event (i.e. 90% of all 4-hour events are of equal depth or less). Model results indicated model stability and demonstrated the model representations of a remote treatment facility.

Review of model updates

Moffa and Associates (M&A) staff presented a review of tasks performed following the April 4, 2000 TRC meeting. Level meter installations upstream and downstream of the Kirkpatrick Siphon were reviewed and the influence of the monitored headloss on the Spencer Street interceptor bypass was discussed. Monitored headloss across the siphon matched well with theoretical values. M&A presented results of a 1991 continuous SWMM/EXTRAN simulation with additional model elements at the downstream end of the model system and a revised downstream boundary condition for the Main Interceptor System (MIS). The revised model data set included the Spencer Street bypass, Kirkpatrick Siphon and Metro WPCP headworks. The one-year continuous simulation indicated insignificant overflow volumes at the Spencer Street Bypass when compared with the total system overflow volume (Note: previous analysis identified 1991 as a "typical" year for characterizing overflow volumes and the collection system's response to wet weather).

M&A staff presented results of model calibrations for two wet weather events during April 2000. Time series comparisons of the modeled and monitored interceptor levels at the Spencer Street Bypass for the two events validated the model's ability to characterize overflows at this location. Results of the calibration indicated a critical intensity of 0.25 inches/hour as the treatment rate of the bypass, and M&A staff presented an intensity-based estimate of bypass overflows using a long-term hourly precipitation record. The TRC suggested M&A compare 15-minute intensities with hourly intensities for periods of record when both databases are available to verify estimates of overflow frequency at the Spencer Street bypass. The TRC also suggested that M&A staff develop a list of potential locations for installation of rain gages to support further model analyses and calibration.

Review of TRANSPORT/EXTRAN model training
M&A staff provided an overview of methods employed to "train" the TRANSPORT model to simulate the collection system's response during wet weather based on analyses using the full dynamic routing capabilities of the EXTRAN model. Ten TRANSPORT models were developed using static treatment rates in regulator pipes to limit inflows to the interceptor system based on review of EXTRAN simulations for the selected storm. The TRC suggested comparison of model overflow volumes and capture between the TRANSPORT and EXTRAN 1991 continuous simulations to validate the training of the TRANSPORT model.

Review of RDI/I and calibration documentation
M&A staff and the TRC discussed the existing representation of Rainfall Dependant Inflow and Infiltration (RDI/I) in separate sanitary areas tributary to the MIS. Because separate sanitary areas tributary to the MIS are regulated at CSO chambers and are not directly connected to the interceptor, the influence of these areas on MIS regulator treatment rates is considered negligible. The TRC suggested M&A verify the sewershed acreage of all separate sanitary areas tributary to MIS regulators and perform a sensitivity analysis of the RDII on model-estimated CSO volumes at these discharge locations. The TRC suggested utilization of Cumulative Distribution Function (CDF) plots to document comparisons of modeled and monitored hourly inflows to the Metro.

Model simulation review
M&A staff presented dynamic results of several model simulations. Both Existing and Proposed CSO Abatement Conditions model simulations were presented. This review verified general model stability and representation of key elements in the collection system, but did not include a comprehensive review of all modeled elements or scenarios. Estimation of percent capture using various techniques to derive the base wastewater component of combined sewage was discussed by the TRC. The defining of "wet" hours using SWMM/RUNOFF inflow duration was determined the most defendable technique.

Conclusions and Recommendations of the Technical Review Committee

Based upon the information presented by M&A at the two meetings, the TRC found no obvious or systemic problems with the development, calibration and utilization of the models. The principal issue is the lack of a systematic documentation of the details and assumptions behind the model setup, development, applications and results. Apparently, over the many years of model development, there was never a contractual requirement to provide a comprehensive documentation of the modeling process. For the most part, with the exception of some memorandums, it appears that only model results were documented, and those were documented in the context of supporting proposed system modifications.

A comprehensive report describing the modeling work will provide a firm basis for understanding the technical work preformed in support of the CSO remediation planning performed over the past decade. Perhaps even more importantly, the report would fill an existing gap in the OLIP's CSO program's compliance with the requirements of the national CSO policy. It likely is true that the maturity of the OLIP CSO program and the adjudicative nature of the capital projects approval status may preempt the actual requirement for a hydraulic characterization report as suggested by the national CSO policy guidance. However, a program such as the OLIP that has placed such a high degree of reliance upon a presumptive approach to CSO regulatory compliance should have a hydraulic characterization report available for review by those who wish to examine and understand the technical basis of the program. The presumptive approach is a unique artifact of the national CSO policy and the supporting policy guidance documents. It is recommended that, to adequately support the approach and ensure a defensible posture in its application, another important element of the policy guidance also should implemented, and that is the requirement to prepare a hydraulic characterization report.

Principal Recommendation

The principal recommendation of the TRC is that a report be prepared, documenting the history of the development of the hydrologic and hydraulic models, including a rigorous, comprehensive description of:

model representation of the physical system
- basin/sub-basin model organization; maps and tables showing drainage sub-basins, sewershed areas, catchment areas and the RUNOFF basins and associated statistics
- network data development; schematics of the collection system and the model representation of the system; data set development; document network data verification process
- schematics of modeled domain of the receiving waters and the model representations of the channels and other features

- hydraulic assumptions and model accommodations made to represent all the hydraulic elements included in the model (e.g., regulating chambers, pumps, hydraulic controls, equivalent pipes and channels, etc.)
- determinations of base wastewater flows, groundwater infiltration and rainfall dependent infiltration/inflow; methodology for geographic distribution of BWWF, GWI and RD/II in model segments

theory and selection of calibration, verification and simulation periods and the source, quantity and quality of the precipitation and temperature data used to prepare the input data sets

calibration/verification documentation

- combined sewers: dry weather calibrations; wet weather- impervious area, infiltration parameters, other parameters
- separate sewers: dry weather flow calibrations; wet weather calibrations
- use: short term and long term water balance tables; time series observed-simulated plots; observed-simulated scatter plots; overlay cumulative distribution plots of observed data and simulation results

identify and discuss data needs for future model refinements

A report documenting the above model characteristics will prove valuable to Onondaga County, as the CSO model is the basis for design of the major facilities included in County's CSO program, and indeed of the program itself to a large extent. For example, the presumptive approach compliance of the program with established CSO planning targets (i.e. 85% or greater capture achieved by the various facilities) can only be demonstrated with the model. As noted above, the absence of comprehensive documentation of model therefore hampers confirmation of the model as a valid basis for the County's CSO program.

General Recommendations

Additional recommendations were made during the course of the TRC are listed below. Some of these have been implemented recently by the OLIP modeling team.

- Expand the EXTRAN and TRANSPORT models to include the Spencer St. bypass, Lower Crossing siphon and connection of Harbor Brook and MIS systems with the Metro WPCP screen and grit chambers.
- Expand the RUNOFF models to include all separate sanitary areas tributary to the MIS and Harbor Brook collection systems.
- Investigate the impact of EXTRAN and RUNOFF expansions - documented above – on CSO abatement facility 1-year design storm hydrographs.
- Obtain Metro WPCP hourly inflow monitoring data for additional calibration and documentation.
- Perform and document additional model vs. monitor flow, level and overflow occurrence comparisons at CSO outfalls, the Lower Crossing siphon and inflows to the Metro WPCP.
- Develop a list of potential sites for installation of rain gages to support future model analyses and calibration.
- Compare intensity-based estimates of CSO discharges at the Spencer Street Bypass using hourly and 15-minute rainfall records when reliable data exists for both databases.
- Compare and document EXTRAN and TRANSPORT CSO discharge volumes and captures for a one-year, 1991, simulation.
- Verify separate sanitary sewershed delineations tributary to the MIS and perform sensitivity analyses of the RDII on model-estimated CSO discharges at downstream regulators.
- Obtain Metro WPCP hourly inflow monitoring data for additional calibration and documentation using CDF plots.

Implementation of the above recommendations are not expected to significantly change the design parameters for the County's proposed CSO facilities (although, as noted above, this assumption should be tested). The assumed insensitivity of the design parameters to the above modeling work reflects the design approach for the facilities, which is based on establishing a design flow rate at the various points of CSO discharge which are to be directed into the proposed facilities. While the above modeling work will likely not change the estimated design flows at the individual CSO facilities, any changes in design assumptions to reflect recent corrections to previous errors in the modeled % capture estimates could change facility sizing requirements. Rather than directly change design parameters, the above modeling recommendations will:

(a) expand and enhance the County's overall understanding of the response of the CSOs and collection/treatment systems to wet weather (which could lead to changes in CSO facility design assumptions); and

(b) enhance confidence in the ability of the model to reliably support the County's CSO program.

APPENDIX F

VORTEX SEPARATION

Vortex Separator Installations

State/Country	Facility	General/Design: Consent Order Driven	Number of Swirls	Total Treatment Capacity (mgd)	Swirl Diam (ft)	Disinf	Swirl Hydraulic Loading Rate (gpm/sf)	Above or Below Ground	Location (Comm./Resid./Industrial)	Operational Since	Swirl Type	Odor Control	Equipment	Operation and Maintenance Features: Sampling After Storm	Maintenance After Storm	Routine Maintenance	Number of Staff	Hours	Certification Required	Annual Costs ($): Chemical	Inspection	Flow Monitoring	Electrical	Notes
NY	Onondaga County Midland Ave RTF	Yes	4	440	42	Yes NaOCl	55	Above	Residential	Prelim Design	US EPA	Y	Screw pumps, coarse screens, underflow pumps, swirls											Predicted 90% removal of settleable solids and floatables
NY	North Yonkers PS	Yes	3	77	19	Yes NaOCl	63	1/2 Above	Mixed Use	May-90	US EPA	N	Automated bar screens, flow split to 3 swirl concentrators, underflow pumped to PS, submersible pumps in PS pump back to interceptor to WWTP, overflow goes to chlorine contact chamber and to outfall	Crew does Settleable solids and residual chlorine; outside lab does BOD, TSS, Fecal coliform, and oil and grease	Wash down the swirls	Flush pumps every 6 months with clean water, oil belts	1-6, only 2 needed during storm	24 hr. operation, this is main facility						Have had minimal problems with facility, but do like the grit system up front, also like the Gorman Rupp submersible pumps for underflow
NY	Flushing Bay CSO Facility	Yes	3	400	45	No	62	Below	Residential	Oct-98	US EPA, Storm King -HIL, and Fluid Sep -Grande, Novac	Y	Mechanical bar screens, flow goes to swirls (depending on flow, all 3 may not be in use), overflow of all 3 goes to waste effluent chamber, underflow goes to foul waste PS (contains grinder pumps) then combines in waste effluent chamber PS and is pumped to WWTP	Extensive monitoring program begins after city accepts facilities plan, then the city will take over the unit (first 3 way comparison of the EPA Swirl, Grande Novac Fluid Sep, and HIL Storm King	Wash down the swirl	need to clean bar screens 1-2X/day	1 Senior, 3 STW's for all 3	Unmanned facility, alarms send signals to operators	Knowledge of collection system					Problems with grinder pumps receiving underflow clogging. URS is looking at increasing the distance between the housing and impeller. Dry weather flow goes to PS and then to WWTP.
NY	City of Oswego	No	1	3.45		No		Below	Mixed Use	Jun-81		N	Flow enters wet well, bar screens prior to swirl, underflow goes to grit removal then to main WWTP. Grit is loaded into trucks and hauled	Sampling for 1 hour during event is required	Grit removal as needed Approx. 1/wk	weekly check	Manned during storm events only for sampling		State Cert 3A operators					
NY	City of Auburn - CSO 06		1	4.8 - 8.4	14.7	Yes NaOCl	22.9	Above	Residential	Apr-97	US EPA	Y	Manual bar screens, swirls and disinfection only. Underdrain to interceptor sewer		Clean the swirl, remove coarse floatables		Use WWTP staff when telemetry equipment sends signal							
NY	City of Auburn - CSO 07		1	3.3 - 7.1	12.8	Yes NaOCl	40	Above	Residential	Apr-97	US EPA	Y	Manual bar screens, swirls and disinfection only. Underdrain to interceptor sewer		Clean the swirl, remove coarse floatables		Use WWTP staff when telemetry equipment sends signal							
NY	City of Auburn - CSO 029A		1	4.0 - 8.9	14.1	Yes NaOCl	40	Above	Residential	Apr-97	US EPA	Y	Manual bar screens, swirls and disinfection only. Underdrain is pumped to WWTP		Clean the swirl, remove coarse floatables		Use WWTP staff when telemetry equipment sends signal							
NY	City of Auburn - CSO 017		1	5.5 - 11.8	15.75	Yes NaOCl	42	Above	Residential	Apr-97	US EPA	Y	Manual bar screens, swirls and disinfection only. Underdrain to interceptor sewer.		Clean the swirl, remove coarse floatables		Use WWTP staff when telemetry equipment sends signal							
NY	Syracuse	N	1	6.8	12	Yes	40			Feb-79	US EPA	Y												
CANADA	Ontario Pilot - City of Scarborough	N	1	(0.5 - 40 m/h)	10	Yes		Above		Jun-94	Storm King - HIL	Y	Head tank, swirl. Conventional clarifier											Pilot study comparing swirl with coagulants vs. conventional primary clarifier for primary clarification
CT	City of Hartford	Y	2	60	30	Yes NaOCl	26.5	Above	Mixed Use	Apr-96	Storm King - HIL	Y	No bar screens, wet well before dynamic separators, storage basin		Basin is drained and cleaned	Underflow chamber requires constant maintenance (sludge accumulation)	As required, facility is unmanned							May have been undersized
District of Columbia	Northeast Boundary CSO Facility	Y	3	400	57	Yes NaOCl	10 - 38 (depending on source)	1/2 Above	Commercial, RFK sports stadium, hospital	Jun-91	US EPA		Inflatable fabridam, PS for low flows, larger storm goes to swirl separator, coarse bar screens, swirls, disinfection, dechlor. Gravity influent, underflow is pumped to WWTP.	Sampling is done during storm event, approx. 45 minutes after chemical disinfection starts	Flush, screens, [illegible] sludge, hose down swirls to WWTP via pumps	Complete inspection on a weekly basis	Manned during storm events only							
GA	Columbus Water Works - South Commons Water Resource Facility	Y	6	72	36	Yes	5 - 11.5	Above		Dec-95	Storm King - HIL		Automated bar screens, PS splits flow to 5 primary vortex separators; 90% of overflow goes to river, 10% concentrated solids to grit separator [illegible] and then to a secondary swirl for any lost organic matter or solids removal											
GA	Columbus Water Works - Uptown Park Water Resource Facility	Y	6	48	32	Variety	2.5 - 6 for Direct Treatment and 4 17 for Fill and Treat	Below	Residential	Dec-95	Storm King - HIL		Automated bar screens, 4 primary and 2 secondary vortex separators, dissolved air flotation units, compressed media filters, many types of disinfection	24 bottle refrigerated samplers are used to take "flush weighted" grab to incoming mass as opposed to flow; as influent and effluent: TSS, E coli, fecal coliform, nutrients, metals and other conven parameters	Screenings and grit are removed and sent to landfill	Check chlorine concentrations every week	2 (of which 1 is on call during storm)	8 hr shift, not 24 hr operation	1/2 certified					Doing an extensive disinfection study now
IL	City of Decatur - McKinley Ave CSO Facility	Y	1	40	25	No	57	Below	Residential	Feb-86	US EPA	N	No bar screens, just swirl concentrator		Clean the 1st flush tank and swirl	Check facility 1x/week	1 for clean-up after storm, 1 for weekly inspection	8 hr shift after storm, 4 hrs every week for inspection	Maintenance staff, not certified					Facilities function very well, swirl removes a lot of grit, need to work on adding some form of screening before swirl
IL	City of Decatur - Lincoln Park CSO Facility	Y	4	416	44	No	47	Below	In park	Feb-92	Fluid Sep - Grande, Novac	N	Coarse bar screens (catenary), 1st flush tank (circular and no baffles or weirs), balance of flow goes to swirls, underflow by gravity to PS, submersible pumps in PS pump back to interceptor to WWTP		Clean the 1st flush tank and swirls	Check facility 1x/week	2 for clean-up after storm, 1 for weekly inspection	8 hr shift after storm, 4 hrs every week for inspection	Maintenance staff, not certified					Facility functions very well, swirls remove a lot of grit, need to either manually remove often or have grit removal process, unmanned facility (use telemetry), advices rectangular 1st flush (holding tank) with tipping buckets: they aerate, mix and remix 1st flush tank
IL	City of Decatur - 7th Ward	Y	1	112	45	No	49	Below	Residential	Feb-80	Fluid Sep - Grande, Novac	N	Coarse bar screens (catenary), 1st flush tank (circular and no baffles or weirs), balance of flow goes to swirl, underflow by gravity to PS, submersible pumps in PS pump back to interceptor to WWTP		Clean the 1st flush tank and swirl	Check facility 1x/week	3 for clean-up after storm, 1 for weekly inspection	10 hr shift after storm, 4 hrs every week for inspection	Maintenance staff, not certified					Facility functions very well, swirl removes a lot of grit, need to either manually remove often or have grit removal process, unmanned facility (use telemetry), advices rectangular 1st flush (holding tank) with tipping buckets; they aerate, mix and remix 1st flush tank.

Vortex Separator Installations

State/Country	Facility	Consent Order	Number of Swirls	Total Treatment Capacity (max. mgd)	Swirl Diam. (ft)	Disinf.	Swirl Hydraulic Loading Rate	Above or Below Ground	Location (Comm., Resid., Industrial)	Operational Since	Swirl Type	Odor Control	Equipment	Sampling After Storm	Maintenance After Storm	Routine Maintenance	Number of Staff	Hours	Certification Required	Cleaning	Inspection	Flow Monitoring	Electrical	Notes
General/Design													Operation and Maintenance Features							Annual Costs ($k)				
IL	City of Decatur - Oakland Ave	Y	1	20	27	No	24	Below	Residential	Feb-92	Fluid Sep - Grande, Novac	N	Coarse bar screens (catenary), 1st flush tank (circular and no baffles or weirs), balance of flow goes to swirl, underflow by gravity to PS, submersible pumps in PS pump back to interceptor to WWTP		Clean the 1st flush tank and swirl	Check facility 1x/week	4 for clean-up after storm, 1 for weekly inspection	11 hr shift after storm, 4 hrs every week for inspection	Maintenance staff, not certified					Facility functions very well, swirl removes a lot of grit, need to either manually remove often or have grit removal process, unmanned facility (uses telemetry), advises rectangular 1st flush (holding tank) with tipping buckets; they aerate, mix and remix 1st flush tank
IN	City of Indianapolis - Pilot Vortex Separator	N	1	20	22	No		Below	Residential	Oct-97	US EPA		Gravity flow in, gravity overflow, pumping of underflow solids back to WWTP	sampling not required but is done periodically	1 for inspection, 2-3 for cleaning	mobile crew, not 24 hr operation	Unmanned: complete inspection on a weekly basis	11 (25x/yr)	2.21	4.8	1.41			Low overflow frequency (1X/month), small unit, small underflow, low head
IN	City of Brownsburg North	N	1	25	25	No	31	Above	Isolated	May-89	US EPA		Gravity flow in, gravity overflow, underflow solids back to WWTP by gravity, no bar screens	previously did sampling but no longer required	wash down grit if needed	weekly check, monthly wash down	unmanned							Wash down is only maintenance
IN	City of Brownsburg South	N	1	36	29	No	41	Below	Isolated	May-89	USEPA		Gravity flow in, gravity overflow, underflow solids back to WWTP by gravity, no bar screens	previously did sampling but no longer required	wash down grit if needed	weekly check, monthly wash down	unmanned							Wash down is only maintenance
IN	City of Auburn	N	1	32	28	No	36	1/2 Above	Mixed Use	Oct-84	US EPA	N	Gravity flow through bar screens into wet well, pumped to swirls, underflow to WWTP by gravity	outfall is sampled when swirls are in operation	none	weekly check, clean swirls yearly, empty debris from mechanically cleaned rack as needed		CSO is located at main WWTP which ops. 24hr/day M-F	None					Only operated when a significant storm is anticipated, 66" sewer line is used as influent reservoir, then swirl is turned on. Operating cost is lumped in with main WWTP. Originally designed for chlorine but no longer use it due to problems adjusting. Problems: system is under designed; detention time is too short; almost no removal is accomplished; first flush from heavy rain all goes to through swirl to stream
MA	City of Roxbury Pilot (storm water application)		1	3.9	10.5		37				US EPA													
ME	Rockland		1		35	Yes	14-24	Above		In construction	US EPA	Y	Wet weather pump station, high rate disinfection, dechlor, pumps											Maine Design, 85-90% flow goes to swirl
MI	Wayne Co - Redford Twp.	Y	1	~50	35	Yes NaOCl	8.8 - 44	Below	Residential	Jan-97	US EPA		2 parallel compartments preceded by swirl concentrator	Samples from the basin influent and effluent are collected as discrete and composite samplers, overflow and underflow from the swirl concentrator is collected as a discrete sample	Clean screens, check equipment, possible rinse swirl	Underflow pumps, should oversize discharge pipe	ave of 1.4 Full time staff and 2-3 people after storm	8 hr shift, not 24 hr operation	Y				[illegible]	Tipping buckets are used for basin cleaning, rarely NPDES split now between retention basins and swirl; don't use submersible pumps for underflow, use vertical pumps (less O&M), use 2 - 3" screen spacing, anything less increases O&M
MI	City of Saginaw 14th St.	Y	1	64.6	36	Yes NaOCl	44	Below	Commercial	Sep-92	Fluid Sep - Grande, Novac	N	first flush to vortex, then to 2nd cell, then on to 3rd cell, then to outfall	Sample up and down stream during storm event after 1st basin discharge	None, tail end of storm event is mainly rain water and it acts as a rinse	weekly check, clean bar screens yearly	unmanned	When needed, approx. 10 times/year						Very pleased with operation, no maintenance, tipping buckets are very good. 1996 EPA award winner for CSO facilities.
MI	City of Saginaw Weiss St.	Y	3	430	36	Yes NaOCl	69	Above	Commercial	Sep-92	Fluid Sep - Grande, Novac	N	small storm to vortex, medium storm overflow to chlorinator, large storm over flow to retention		None, tail end of storm event is mainly rain water and it acts as a rinse	weekly check, clean bar screens yearly	unmanned	When needed, approx. 10 times/year						
PA	City of Lancaster	N	1	26	24	No	40	1/2 Above	Residential	Sep-71	US EPA		Gravity flow in , gravity overflow, underflow solids back to WWTP by gravity, no bar screens		none	none	unmanned							System could not meet sampling requirements at the time, city did not want to pay and operate the system, so CSO flow goes into the stream
VT	City of Burlington	Y	1	75	40	Yes NaOCl/NaBr	41.4		Mixed Use	Jun-94	Fluid Sep - Grande, Novac	N	Diversion structure to CSO wet well with bar screens, flow to vortex separator, custom screen on outlet of vortex sep to catch feals and rags that overflow, overflow to CSO chamber, underflow is pumped back to plant	TSS, Total Residual Oxidant (as Cl), and E Coli for permit; BOD, TP, Nitrate N, Ammonia N, settleable solids, pH for monitoring only	Remove excess screenings/grit and bring to landfill transfer station, clean material from vortex effluent grates, fire hose settled grit in CSO wet well and vortex sep	Quarterly - Remove grit from CSO and foul sewer wet wells; Routinely -oil changes on CSO pumps, foul sewer pumps, chemical feed pumps, CSO bar screen, replacement of worn broken parts (wear rings, impellers, seals, chem pump diaphragms)	1 chief, 4 operators	1 shift/day: 6-8 hrs per storm, 4-6 hrs after storm, 1 hr testing per storm	Grade 5 NPDES required for chief operator, others operators encouraged to get highest possible NPDES license	25	Outside Testing Lab - $1800	Disinfection Chemicals $2190 for NaOCl and $14600 for NaBr	$7k for foul sewer, $3k for CSO ($10k total)	Often solids settle out in box culvert and CSO wet well before the vortex separator; use a vacuum truck to remove 80 - 100 cubic yards of material/year. ultrasonic flow meter measures the head over the discharge weir. chose bromine/hypo chlorination scheme because Lake Champlain requires a very low residual (0.0.11 mg/l chronic and 0.019 mg/l acute)

APPENDIX G

ORF'S

APPENDIX G

TO BE DEVELOPED

APPENDIX H

MEMORANDUM-TETIARY CLARIFIER INSPECTION REPORT

ONONDAGA COUNTY

DEPARTMENT OF DRAINAGE & SANITATION

INTER-OFFICE MEMO

****

TO: Randy Ott **FROM:** **DATE**: 10/19/99

JAMES E. BRADY
MAINTENANCE SUPERINTENDENT
OFFICE:
ADMINISTRATION
SUBJECT: Tertiary Clarifier Inspection

Inspection of #4 Tertiary Clarifier conducted by myself and Jim Zemotel on 10/11/99. #4 was one of the better tanks. This report applies to all tanks as general conditions.

All Tertiary Clarifiers

1) **Concrete decks**: surface spalling from wear and tear since 1959, chunks of concrete missing at corner handrail post embedments, some stair nosing missing.
Recommendation: rebuild damaged areas, replace missing stair nosing and resurface top.
2) **Superstructure:** catwalk steel scaling under grating and spotty elsewhere.
Recommendation: sandblast white and repaint w/ 2 part epoxy. Perform in-place, since to pull superstructure means pulling the four support arms, center tubes and collector arms, as well as flocculator table and collector arms (everything must be removed).
3) **Kickplates:** pressure treated wood w/ u-bolts aging, not the same vertical spacing tank to tank, do not meet current safety codes.
Recommendation: replace w/ aluminum.
4) **Microfloc tube settlers**: brittle, damaged, missing areas, steel supports repaired many times from vibration wear and rusting, many sections have collapsed during tank drawdown. All microfloc has been removed from #5 tank.
Recommendation: remove and dispose of all microfloc and supporting hardware.
5) **Concrete support arms** supporting microfloc and weir launders: good condition, no spalling.
Recommendation: clean and protect with bitumastic coating.
6) **Sludge collector plows, center columns and steel sweep arms**: heavily coated with iron scale from iron salt chemical usage, some scaling of steel but otherwise sound.
Recommendation: sandblast white and coat w/ epoxy paint in place, replace brass squeegee and stainless hardware.
7) **Flocculation table w/ sludge collector sweep arms**: heavily coated with iron scale from iron salt chemical usage, some scaling of steel, not in use since late 70's, table removed from #5 clarifier.
Recommendation: unbolt, remove and dispose.
8) **Gate Operators**: All reported working fine, no deterioration.
Recommendation: Leave alone.

9) **Clarifier Floors**: many areas of bottom have been previously coated with a topping and screeded w/ collector plow. Condition is excellent in most tanks. Some cracks have been repaired in past and are holding up well. Bottom of tank moves independent of wall and grout repairing the resulting crack and leak to ground has not been successful due to continued movement.
Recommendation: contract to include survey each tank and resurface areas of floor yielding excessive clearance (over one inch) and epoxy repair cracks. Do not include joint of wall to floor.

10) **Clarifier Walls**: Spalling at anchor points for superstructure, numerous repairs w/ non-shrink grout and/or welded plates, still some more to do. Some spalling of cementacious coating on several tanks.
Recommendation: schedule anchor repairs w/ non-shrink grout and coating repairs for spring 2000 now.

11) **Sludge Collector Primary Drive Units:** Gear reducers with Sterling motors dating back to at least 1977. #3 tank had motor replaced some 5-6 years ago. Output shafts worn at seal area. Speedi-sleeves and new seals have been installed on 4-5 of the clarifiers so far.
Recommendation: Replace primary gear reducers.

12) **Sludge Collector Secondary Drive Units(Dorr Oliver):** were rehabilitated in 1977, are in good condition, P.M.'s not revealing any problems.
Recommendation: Have a factory representative evaluate them for need of refurbishing.

13) **Lime Feed Piping:** Not used since late 70's.
Recommendation: Remove and dispose.

14) **Scum Houses**: groundwater leaks into them and we periodically pump them out. Sump pumps were removed years ago to prevent theft and reduce maintenance costs.
Recommendation: Determine future use of scum house.

<u>Still need inspection:</u>
<u>Tertairy Pump Station</u>
<u>Tertiary Sludge Pumps (Moyno's)& Piping, valves, etc.</u>

Metro Tert. P.S.

Onondaga County
Department of Drainage and Sanitation

Inter-Office Letter

To: Jim Brady
cc. Len Moody

From: Jim Chase JC

Subject: Tertiary Distribution Restoration
Date: October 21, 1999

The following are items that would need attention to keep the Tertiary system in service for the next 20-25 years:

- Upgrade lightening protection system on tanks and distribution structures
- Replace Louis Allis adjusto speed motors and drives, could retrofit new motors and VFD's to the existing pumps
- Replace existing clarifier motors and gear boxes
- Replace conduits \ wires \ receptacles start-stop stations on tanks if needed
- Replace lights on distribution structures
- Replace or remove lights on tank catwalks
- Replace control panel for motorized valve operator
- Repair distribution structure where conduits enter building, currently get a lot of water penetration in wet weather

ONONDAGA COUNTY

DEPARTMENT OF DRAINAGE AND SANITATION

INTER-OFFICE LETTER

TO: Jim Chase

FROM: Thomas M. Campbell

OFFICE: I/E South

SUBJECT: Metro Tertiary

DATE: 10-27-99

1. Tertiary Sludge Recycle flow meter not needed.
2. Tertiary Tank 1-6 Sludge flowmeters, need to replace the secondary electronics. $1,800.00 each, $10,800.00 TOTAL.
3. Tertiary Venturi purge system upgrade. (Plumbing) Side A&B, $400.00 each, $800.00 TOTAL.
4. Tertiary pump discharge pressure gauges. 8 total A&B sides, $450.00 each, $3,600.00 TOTAL.

APPENDIX I

DETAILED ANALYSIS OF SCHILLER PARK STORAGE OPTION

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

MEMORANDUM

TO: Joel L. Swanson

FROM: Craig R. Smithgall

DATE: January 15, 2001

CC: Dave Kerr, Bob Butterworth

Description of Schiller Park Storage Option

The Schiller Park CSO Storage Option would involve the construction of an underground tank at Schiller Park on the Butternut Trunk Sewer that would provide temporary storage of excess combined sewer system flows. The storage tank would accept flow from two new combined relief sewers in addition to the Butternut trunk sewer. The facility would have multiple beneficial impacts:

- Provide significant reduction in the frequency and duration of CSO discharges to Onondaga Creek. The major beneficial impact would be on reduced bacterial loadings
- Reduction in the frequency and duration of events treated at the Franklin Floatables Control Facility. This would reduce the required operation and maintenance cost at this facility.
- Reduction in the frequency and duration of discharge events at the Spencer Street bypass
- The storage facility could operate in either an on-line or off-line mode depending upon the size of the storm event.
- Provide relief to the residents of Highland, Knaul and Butternut Streets and Hier and Grumbach Avenues whose basements are frequently flooded by backups from the local combined sewer system. The option would also significantly reduce the problems of street flooding in this same area.

The storage system would allow control of a significant portion of the combined and separately sewered acreage on the north side of the City of Syracuse. The project would directly affect the discharge of 579 acres of combined and sanitary sewer above the facility in addition to 261 acres that are tributary to the Butternut trunk sewer at Teall Avenue (CSO 073). The option would indirectly affect the wet weather flow from 330 acres downstream from the facility by allowing more of that flow to enter the Main Interceptor Sewer.

Preliminary cost estimates have been developed for this option. The option sized to provide flooding relief to the Highland area would cost approximately $11.4 million to accommodate a 5-year design storm. If a 10-year design storm is used the cost rises to $12.7 million.

Components of the System

The option would require the construction of the following elements:

Underground concrete Storage Tank in Schiller Park. As noted above, the initial evaluation of this option has been based upon providing storage for either the 5 or 10 year storm events for the Highland area. These values were selected as the potential basis of design for the storage tank and pipelines to prevent street flooding in the Highland area. The volume of the tank for 5 and 10-year design storms would be 3.4 and 4.1 million gallons respectively. The location in Schiller Park that is being considered for this option would allow a tank of approximately 12 foot in depth. With this depth, the tank would be approximately 195 feet square for the 5-year storm, and 215 feet square for the 10-year storm. The tank would have a concrete cover that would allow its continued (and expanded) use as a baseball and softball facility. Odor control and washdown facilities would be required. Following tank dewatering, sediment would be flushed back into the Butternut Trunk Sewer. A portion of the heavier sediment or grit could be retained in the tank by constructing a grit "sump." This heavier material could then be removed following dewatering of the tank and flushing of the lighter material. The use of Hydroself or similar "tipping bucket" equipment would be used for flushing. Swirl concentrators or other vortex devices would not be required. Control gates (sluice gates or inflatable dams) would be used to control release from the facility when downstream conditions allow. Preliminary design layout for this facility shows that influent pumping would not be required. The system would operate as a gravity-in, gravity-out system.

<u>Combined Relief Sewer from Knaul and Butternut Streets</u>. A combined relief sewer would be constructed starting at Butternut Street to provide additional wet weather flow capacity and intercept the flow that currently surcharges the Highland Trunk Sewer. This sewer would be approximately 2300 feet long and be constructed of 36-inch to 48-inch pipe. Wet weather flow from approximately 212 acres would be directed to the storage facility via this sewer. In the section along Butternut and Knaul Street, the pipe would operate via gravity. The remaining section along Heir Street, Grumbach, and into Schiller Park would be a pressure sewer and not accept any additional drainage. This would be done to minimize the depth of construction and associated costs. The existing and new sewers within the flood prone Highland area would then have sufficient capacity to handle flows up to a 10-year storm without surcharging.

<u>Combined Relief Sewer from the Whitwell Drive and Mertz Avenue Area</u>. Approximately 76 acres discharge to the Butternut Trunk Sewer via a sewer that currently connects to Grumbach Avenue. Wet weather flows would be diverted from this basin to the storage tank via a 200-foot long, 36-inch diameter sewer.

<u>Sluice gates.</u> Two sluice gates would be used to control the flow into and out of the storage tank. One would be located at the upstream end of the tank and another at the downstream end. Another separate gate would control the flow of the Butternut trunk sewer at the upstream end. Collectively these gates would allow the system to be operated as an on-line or off-line storage facility. The gates would be opened and closed as appropriate to store or release combined sewage. Additional gates may be used internal to the tank to manage flow between different compartments. During dry weather the sluice gates would be used to isolate the atmosphere in the tank from that within the Butternut trunk sewer.

<u>Real time control system.</u> A real time control system would allow operation of the storage basin and associated regulating devices. The system would include level sensors in the storage basin, on the Butternut Trunk Sewer, at the Franklin Floatables Control Facility, at Highland Street, at Schiller Park and at Teall Avenue. Flowmeters would also be incorporated on all three influent lines to the storage tank as well as the Butternut trunk sewer as it exits the facility. Rain gauges would be installed at two

or three locations within the Butternut basin. The system would be operated via a SCADA system based at METRO. The SCADA system would allow control of the sluice gates during storage tank drawdown operations to ensure that the flow would not induce an overflow at Onondaga Creek or activate the Franklin FCF.

Operational Approaches

The storage facility could be operated as either an on-line or off-line facility using the three sluice gates. For normal events the facility would be operated as an on-line facility and would trap the flow of the Butternut Trunk Sewer in addition to that of the two combined relief sewers previously described. When exceptionally heavy rains are expected, the facility would be operated in an off-line mode with the storage capacity being reserved to reduce flooding in the Highland area. Flow within the Butternut trunk sewer would continue to pass downstream without being stored for this off-line operational approach. Computer simulations indicate that this could be done without causing flooding problems in the Highland area.

Impacts on CSOs

The Schiller Park storage option would control the flow of the Butternut trunk sewer and the amount of combined sewage being discharged from CSO 020. Currently, wet weather flow from the Butternut trunk sewer receives treatment to remove floatables and gross solids prior to being discharged. The Schiller Park storage option will significantly reduce the frequency and magnitude of events being treated at the Franklin Floatables Control Facility. Computer simulations have been performed for the 90% and 1-year storms to demonstrate this concept. The volume of flow through the FCF is reduced by over 35 percent for the 90 percent design storm, while the peak rate is reduced by approximately 50 percent. For the one-year storm, the volume is also reduced by about 35 percent with a 10 percent peak rate reduction.

One of the most significant impacts would be on the reduction in the annual CSO discharge volume. Simulations performed by Moffa & Associates indicate that the Schiller Park storage option would reduce the annual volume discharged at CSO 020 from 81.5 million gallons to 7.7 million gallons. This 91 percent volume reduction is possible since the majority of rainfall in an average year is at lower intensities than that of a 90 percent or one-year design storm. Additional simulations would be provided as part of the preliminary design of this option to determine the benefits of different tank sizes. For larger storms (5- or 10-year), the Franklin FCF will still see high flow rates owing to the combined sewer acreage below Schiller Park.

Impacts on the Neighborhood

Construction of the storage option would significantly reduce the basement flooding problem in the Highland area along with the street flooding. A survey of twenty properties in this area was performed in 1999. Many of the homes reported that they have backups from the combined sewer two or three times per year. A few properties reported more frequent flooding. The Schiller Park option would incorporate combined relief sewers as noted above. These relief sewers will intercept excess wet weather flow from the local combined sewer system and divert it to the Schiller Park storage tank.

There will be short term impacts on the neighborhood associated with the construction of the combined relief sewers.

The construction of the storage tank in Schiller Park will also cause short term disruption in the park. The lower athletic fields will be unusable for approximately two years. Following the restoration of the park there will be no depressions in the "outfield" as currently exist. This will constitute an improvement to the current situation. A small above ground building will need to be constructed on the side of the park near Grumbach Avenue. This building will house controls and odor control equipment.

Implementation Issues

This option was not included as part of the Amended Judgement on Consent for CSO abatement. It is recommended that this project be incorporated into a revised CSO abatement plan so that funding may be secured as an official Onondaga Lake cleanup project.

The construction of this project will also require the cooperation of the City of Syracuse in the construction of the storage tank in Schiller Park and the combined relief sewers within City street right of ways. One or possible two properties or permanent easements along Grumbach and Heir Avenues will have to be purchased for the construction of the combined relief sewer.

Recommendations

It is recommended that additional work be done to further develop this option to a facility planning level. Specific recommendations include:

1. Flow and rainfall monitoring – It is recommended that flow meters be installed at:

- Butternut trunk sewer in Schiller Park
- Mertz Avenue sewer
- Highland trunk sewer on Butternut Street
- Butternut trunk sewer on Teall Avenue

These meters would supplement the permanent flow meter on the Butternut trunk sewer at the Franklin FCF and provide sufficient data to calibrate and validate the computer model of the Butternut Trunk Sewer (Stearns & Wheler, 1999).

2. Model calibration and validation of the existing Butternut trunk sewer system.
3. Assessment of impacts of the Schiller Park storage option using calibrated model. This would include demonstrating the impact of the option on reduced flooding in the local combined sewer system, operation of the Franklin FCF, Spencer Street bypass. On-line and off-line simulations would be conducted for storage tanks of different sizes. The analysis should also include the continuous simulation for the "average year" of 1991 to determine the annual CSO volume reduction benefits.
4. Refine the flow interception schemes for the two combined relief sewers

5 Conduct a preliminary subsurface exploration program to identify depth to bedrock, groundwater levels and the soil types that will be encountered at the site. This work is necessary since a majority of the option's cost is associated with the storage tank. Three or four borings should be done in Schiller Park. It is also recommended that a groundwater monitoring well be installed in one of the boreholes to allow monitoring of groundwater for a one year period.
6. Prepare preliminary design layouts of the storage tank, the connecting combined relief sewers, control valves and gates, flushing systems and ventilation and odor control facilities.
7. Prepare updated cost estimates for this option.

APPENDIX J

ERIE BOULEVARD STORAGE SYSTEM, HYDROLOGIC/HYDRAULIC EVALUATION

MEMORANDUM

	Ken Knutsen (BBL) Bob Duclose (CDM/C&S)	**CC:**	
From:	Daniel P. Davis, P.E.	**Date:**	8/30/2000
RE:	Erie Blvd. Storage System Hydrologic/Hydraulic Evaluation	**File:**	154.01

BACKGROUND

The Erie Boulevard Storage System (EBSS) is a large dameter storm sewer running underneath Erie Boulevard that has the capacity to store the discharge that results from a 90th percentile storm over its tributary area. The 90th percentile storm is a storm that is derived from local rainfall data, whose total rainfall is not exceeded more than 10 percent of the time during an average rain-year. The EBSS is approximately 7.5 feet by 10.5 feet with a total volume of approximately 5 million gallons. Additionally, there is approximately 1 million gallons of storage associated with ancillary conveyance pipe connected to the EBSS.

The EBSS Facility has experienced operational problems from the time it was completed and is currently not functioning in accordance with the original design. The EBSS has automated sluice gates that were designed to entrap CSOs that would otherwise discharge to Onondaga Creek. Stormwater and CSO were to be temporarily stored in the EBSS until METRO had the capacity to accept the flow. This would have been accomplished through the use of the automatic control gates and an integrated monitoring system. The original intent was to monitor each storage compartment, Onondaga Creek, the Main Intercepting Sewer, and the Burnet Avenue and Fayette Street Trunk Sewers. Signals from these locations along with other operating signals such as storage gate positions and power failures would be telemetered to a computer at METRO for control purposes.

A total of 9 internal combined sewer overflows (80A, 80B, 80C, 80D, 80E, 80F, 80G, 80H, 80I) discharge into the EBSS during wet-weather conditions. In addition, a separate storm sewered area is tributary to the eastern most portion (furthest upstream) of the EBSS. The gates of the EBSS are currently in their open position and wet-weather flows entering the EBSS are conveyed and discharged to Onondaga Creek. Figure 1 depicts the plan and profile of the EBSS.

The purpose of this memo is to summarize the evaluations conducted to assess the hydrologic and hydraulic aspects of the proposed re-activated facility. A previously developed Stormwater Management Model (SWMM) was used for this purpose.

The SWMM model has been updated with survey information from the overflow manholes and control gate structures obtained during site inspections. Field inspection results are summarized in a report dated March 1, 2000 by Barton & Loguidice, P.D. A schematic of the EBSS Facility, including invert elevations and conduit lengths and sizes, is depicted in Figure 2.

INTRODUCTION

The objective of this modeling effort was to provide greater insight into the operation of the EBSS Facility if it were re-activated. The EBSS system was modeled for a combination of three operational scenarios and three design storms; they are identified as follows:

Operational Scenarios:

- EBSS Facility with gates opened
- EBSS Facility with gates closed
- EBSS Facility with gates closed and flap gate installed on overflow pipe from area 80A (James St. Relief) and 80E (Pine St.)

Design Storms:

- 1-yr frequency, 2-hr duration, 15 minute rainfall interval
- 90% frequency, 2-hr duration, 15 minute rainfall interval (accepted storm)
- 80% frequency, 2-hr duration, 15 minute rainfall interval

- Note The 1-yr frequency design storm is a synthetic hyetograph developed using the Keiffer Chu method. As a frame of reference, the 90% storm produces about half of the peak flow rate of the 1-yr storm, and the 80% storm produces about half the peak flow rate as the 90% storm. Each design storm has a 2-hour duration with 15-minute interval.

Each operational scenario was modeled for each design storm condition. Output from the models included hydraulic grade line profiles within the EBSS, as well as discharge hydrographs from the EBSS to Onondaga Creek. Hydraulic grade line profiles were produced for each operational scenario during each design storm condition. Discharge hydrographs were produced only when such discharges occurred. For example, all three design storms discharged when the gates were opened, but only the 1-yr design storm discharged when the gates were closed.

The model output results are presented by operational scenario; the results of each design storm are discussed as subsections to the operational scenario. Conclusions and recommendations are made based on these results.

APPROACH

The EBSS Facility is modeled as a series of conveyance conduits and manholes. The manholes represent major junctions in the EBSS Facility, including the control gates and the inlets from the CSO areas. The EBSS is constructed entirely underneath Erie Boulevard from approximately Teal Avenue to the Facility discharge at Onondaga Creek. The total length of the EBSS is approximately 8,640 ft, the majority of which is 7.5' by 10.5'. The total volume of the EBSS is approximately 5 million gallons. However, there is approximately 1 million gallons of additional storage associated with ancillary conveyance pipe connected to the EBSS. The EBSS collects stormwater and CSO from the areas shown in Table 1.

Table 1 Tributary area characteristics

Overflow #	Location	Type of Area	Tributary Area (acres)	Contribtion of Flow to EBSS for 90% Storm (Gates Open)
N/A	Erie Blvd.	Stormwater	637	70.1%
80A	James St.	Combined	357	0.2%
80B	Irving Ave.	Combined	128	0.0%
80C	Crouse Ave.	Combined	44	1.3%
80D	Burnet Ave.	Combined	124	10.8%
80E	Pine St.	Combined	37	0.0%
80F	Teal Ave.	Combined	15	0.0%
80G	Teal Ave.	Combined	20	3.3%
80H	Teal Ave.	Combined	178	4.1%
80I	Wescott St.	Combined	76	10.3%

Note: The stormwater area is 637 acres and contributes approximately 70% of the storm volume during the 90% storm, whereas the total combined sewer area is 819 acres and contributes only 30% of the storm volume during the 90% storm. This non-proportional area to flow volume is the result of how the stormwater and combined sewer are conveyed to the EBSS. Stormwater enters directly into the EBSS without hydraulic regulation. Conversely, flows from the combined sewered areas are first hydraulically regulated into the trunk sewers; then excess flows are discharged into the EBSS. A majority of the CSO flow volume from these areas is conveyed to the MIS through the Burnet and Fayette sewer trunks and therefore never reaches the EBSS.

RESULTS

Stormwater Volume vs. CSO Volume

Stormwater is the dominant source of water contributing to the EBSS. Table 2 presents the volume of stormwater and CSO flowing into the EBSS for each design storm assuming existing conditions with the gates opened. During the smaller storms (80% and 90%), the stormwater component is approximately 70% of the total storm volume. During the 1-yr design storm, the stormwater component is approximately 60% of the total storm volume. As previously noted, this change in the percentage of stormwater versus CSO volume is the result of the hydraulic regulation of CSO prior the entering the EBSS. Table 3 presents a summary of EBSS overflows to Onondaga Creek for each modeled scenario and design storm described previously.

Table 2. Stormwater vs. CSO input to EBSS

	Stormwater Component (MG)	CSO Component (MG)
80% Design Storm	2.35	0.95
90% Design Storm	4.48	2.12
1-yr Design Storm	6.79	4.81

Table 3
EBSS Discharge to Onondaga Creek Summary

MODEL SCENARIO		EBSS Overflow to Onondaga Creek
Existing Conditions		
EBSS gates ***open -*** 80% Storm		
	Peak Rate (cfs)	**95**
	Volume (MG)	**3.3**
EBSS gates ***open -*** 90% Storm		
	Peak Rate (cfs)	**250**
	Volume (MG)	**6.6**
EBSS gates ***open -*** 1-Year Storm		
	Peak Rate (cfs)	**550**
	Volume (MG)	**11.6**
Gates Closed		
EBSS gates ***Closed -*** 80% Storm		
	Peak Rate (cfs)	**0**
	Volume (MG)	**0**
EBSS gates ***Closed -*** 90% Storm		
	Peak Rate (cfs)	**0**
	Volume (MG)	**0**
EBSS gates ***Closed -*** 1-Year Storm		
	Peak Rate (cfs)	**202**
	Volume (MG)	**1.96**
Gates Closed & Flap Gates		
EBSS gates ***Closed -*** 80% Storm		
	Peak Rate (cfs)	**0**
	Volume (MG)	**0**
EBSS gates ***Closed -*** 90% Storm		
	Peak Rate (cfs)	**0**
	Volume (MG)	**0**
EBSS gates ***Closed -*** 1-Year Storm		
	Peak Rate (cfs)	**284**
	Volume (MG)	**4.87**

EBSS Facility with Gates Opened

Currently, the EBSS is not operational. The gates are in the open position and the EBSS acts as a large conduit that conveys stormwater and CSO flows from the respective sewered areas to Onondaga Creek. The model results show that under this scenario no storage is achieved, but attenuation of peak flow does occur due to the large "conduit" volume.

As depicted in the hydrograph in Figure 3, the peak discharge to Onondaga Creek is approximately 250 cfs for the 90% design storm. During the peak of this design storm approximately 50% of the EBSS volume is filled as depicted in Figure 4. This an instantaneous hydraulic grade line profile at the peak flow during the storm. Similarly, Figures 5 and 6 depict the hydraulic grade line profile for the 80% and 1-yr design storms, respectively. These hydraulic grade line profiles show that the EBSS Facility does not surcharge during the 80% or 90% design storms and only just begins to surcharge the conduit at the 1-yr design storm. This surcharge occurs upstream of Control Gate # 4 at the inlet from the Burnet Avenue Trunk Sewer – Area 80D. Additionally, at the 1-yr design storm, surcharge conditions can be observed in the stormwater area (Figure 6).

EBSS Facility with Gates Closed

The EBSS was intended to be operated with closed gates during wet-weather events to capture wet-weather flow within the EBSS. With the gates closed, the EBSS functions as a storage facility. The volume the EBSS is not exceeded during the 90% and 80% design storms, but is exceeded during the 1-yr design storm.

90% Design Storm

As depicted in the hydraulic grade line profile in Figure 7, the storage chambers upstream of Control Gates # 3 and #4 completely fill and surcharge during the 90% design storm. When a storage chamber surcharges, the hydraulic grade line crests the top of the control gate and cascade into the downstream storage chamber. This occurs at Control Gates #3 and #4, but does not occur at Control Gate #1. Consequently, the EBSS Facility does not discharge directly into Onondaga Creek during the 90% storm. It is important to note, that although the Facility does not meet its maximum capacity, the surcharge conditions in the storage chambers upstream of Control Gate #4 causes the EBSS to reverse flow back into the Fayette Trunk Sewer. This reverse flows occurs at the Pine Street CSO (80E) and is equivalent to approximately 0.75 MG. This flow ultimately discharges to Onondaga Creek through the Fayette Trunk Sewer. This condition is of particular concern since the Fayette Trunk Sewer is known to have existing flooding problems (as mentioned by County personnel). The gates in the closed position would potentially increase flow toward the Fayette Trunk Sewer under certain flow conditions.

City of Syracuse personnel have also indicated flooding problems along the upper Burnet Trunk Sewer. The location of this has not been identified.

Figure 8 depicts the hydraulic grade line profile at the peak surcharge condition for the storage chamber upstream of Control Gate #4. This figure illustrates the relatively large stormwater input from the areas east of the EBSS. The figure also shows that while the upper storage chamber is at its peak surcharge condition, the two lower storage chambers are not fully utilized. It is also at this time when the greatest reverse flow into the Fayette Street Trunk Sewer occurs through the Pine Street internal overflow (80E). Automatic gate controls on the EBSS gates could be used to reduce the amount of surcharging in the upper storage chambers by passing more flow to the lower storage chamber. In addition, installation of a flap gate at the Pine Street internal overflow could also be used to minimize the reverse flow condition. This is discussed in further detail in the Conclusions and Recommendations.

80% Design Storm

As depicted in the hydraulic grade line profile in Figure 9, the storage chamber upstream of Control Gate #4 completely fills and surcharges during the 80% design storm. However, the storage chambers upstream of Control Gates # 1 and #3 do not completely fill, and consequently the EBSS Facility does not discharge directly into Onondaga Creek. Similar to the 90% design storm, reverse flow occurs from the upper storage chamber into the Fayette Street Trunk Sewer through the Pine Street system. The volume of reverse flow into the Fayette Trunk Sewer is approximately 0.15 MG.

Similar to the 90% design storm, the upper storage chamber fills rapidly with stormwater and surcharges, while the lower two storage chambers are not fully utilized. Automatic gate controls and flap gates could be used as abatement alternatives. This is discussed in further detail in the Conclusions and Recommendations.

1-yr Design Storm

As depicted in the hydraulic grade line profile in Figure 10, all three storage chambers of the EBSS Facility fill and surcharge. During this design storm the hydraulic grade line is such that stormwater/CSO crests the top of Control Gate #1 and consequently the EBSS Facility discharges directly into Onondaga Creek. A hydrograph for the EBSS outfall during the 1-yr storm is presented in Figure 11. Also during this design storm, flows reverse and discharge from the EBSS into the Burnet Avenue and Fayette Street Trunk Sewers through the James Street Relief Sewer (80A) and Pine Street internal overflow (80E), respectively. Approximately 2.1 MG backflows through the James Street Relief Sewer and, 1.0 MG backflows through the Pine Street overflow.

These flows ultimately discharges to Onondaga Creek through the Burnet and Fayette Trunk Sewers. As discussed previously, the Fayette and Burnet Trunk Sewers may be adversely affected as a result of this additional flow that would result during higher intensity events.

EBSS Facility with Gates Closed and Flap Gates Installed

When the EBSS gates are closed, the EBSS functions as a storage facility. However, as previously discussed, during the 90%, 80% and 1-yr design storms reverse flow occurs through the Pine Street overflow to the Fayette Trunk Sewer. Additionally, reverse flow occurs through the James Street Relief Sewer into the Burnet Trunk Sewer during the 1-yr design storm. One alternative that can be implemented to minimize the reverse flow is the installation of flap gates at the inlets of the Pine Street overflow and the James Street Relief Sewer. The model was modified to reflect these flap gate structure and the following results reflect these model changes.

90% Design Storm

As depicted in the hydraulic grade line profile in Figure 12, the storage chambers upstream of Control Gates #1, #3 and #4 fill and surcharge. The hydraulic grade line in the storage chamber upstream from Control Gate #1 is such that flow just begins to crest over the top of the control gate. The resulting discharge to Onondaga Creek through the EBSS is very small.

Figure 13 depicts the hydraulic grade line profile at the peak surcharge condition for the storage chamber upstream of Control Gate #4. The figure shows that while the upper storage chamber is at its peak surcharge condition, the two lower storage chambers are not fully utilized. Additionally, the flap gate installations have eliminated the reverse flow into the Pine Street overflow; however they have increased the surcharging within the EBSS. Automatic gate controls within the EBSS could be used to reduce the amount of surcharging in the upper storage chambers by passing more flow to the lower storage chambers. This is discussed in further detail in the Conclusions and Recommendations.

Another result of the flap gate installations is that a greater volume of stormwater/CSO is stored in the EBSS as compared to the "EBSS Facility with Gates Closed" scenario. With the flap gates installed, an additional

0.75 MG of stormwater/CSO is retained in the EBSS during the 90% storm. The EBSS Facility meets its maximum capacity during this operational and design storm scenario.

80% Design Storm

As depicted in the hydraulic grade line profile in Figure 14, the storage chamber upstream of Control Gate #4 completely fills and surcharges during the 80% design storm. However, the storage chambers upstream of Control Gates # 1 and #3 do not completely fill, and consequently the EBSS Facility does not discharge directly into Onondaga Creek. The flap gate installation prevents reverse flow into the Pine Street overflow, and therefore approximately 0.15 MG of additional stormwater/CSO is retained in the EBSS as compared to the "Existing EBSS Facility with Gates Closed" scenario. Unlike the 90% design storm, this additional volume is not enough to bring the EBSS Facility to maximum capacity.

Similar to the 90% design storm, the upper storage chamber fills rapidly with stormwater and surcharges, while the lower two storage chambers are not fully utilized. Automatic gate controls within the EBSS and flap gates could be used to maximize storage within the EBSS. This is discussed in further detail in the Conclusions and Recommendations.

1-Yr Design Storm

As depicted in the hydraulic grade line profile in Figure 15, all three storage chambers of the EBSS Facility fill and surcharge. During this design storm the hydraulic grade causes flow in the EBSS to crest the top of Control Gate #1, and consequently the EBSS discharges to Onondaga Creek. A hydrograph for the EBSS outfall during the 1-yr storm is presented in Figure 16. The flap gate installation prevents reverse flow into the Pine Street overflow and James Street Relief Sewer, and therefore approximately 3.1 MG of additional flow passes through the EBSS as compared to the "EBSS Facility with Gates Closed" scenario.

As discussed previously, the Fayette and Burnet Trunk Sewers may be adversely affected as a result of this additional flow that would result during higher intensity events. The automatic gate controls within the EBSS could be used to maximize storage and control the extent of surcharge within the EBSS.

Stormwater separation with Conveyance through a Modified EBSS

Consideration was given to modifying the existing EBSS conduit to allow the stormwater component to be conveyed directly to Onondaga Creek, but at the same time capture and store the CSO component. The purpose of this would be to isolate the stormwater from the CSO and discharge the stormwater separately from the CSO flow. In order to accomplish this, the EBSS would need to be sectioned approximately in half, either horizontally or vertically. An initial investigation of this alternative indicated that this was impractical due to the relative elevations of the interconnecting sewers to the EBSS. Overflows connecting to the EBSS enter at different elevations and would not be able to be consistently connected in the top portion of the conduit, if the EBSS was sectioned horizontally. Similarly, if the conduit were sectioned vertically, the conduit would not be able to accommodate the pipes entering from both sides of the EBSS without compromising the flow thru capacity of the conduit. Figure 17 depicts the interconnecting sewers to the EBSS that would need to be considered if such an alternative were to be implemented. In addition, the dividing wall that would need to be added would reduce the existing conveyance and storage capacity of the EBSS.

CONCLUSIONS

- The EBSS Facility has the capacity to store CSO/Stormwater resulting from the 90% design storm.

- During the 90% and 1-yr design storms, significant surcharging in the upper storage chamber (as a result of the control gates being closed) could cause adverse impacts on local sewers as compared to what is currently experienced. Operational flexibility will be important when the EBSS is re-activated. The control gates should be adjusted based on rainfall conditions, water surface elevations, and flow information.

- Automation of the control gates within the EBSS will minimize surcharging by allowing flows to fill lower storage chambers before the upper storage chamber surcharges. In addition, the automatic controls will help in minimizing upstream flooding during more intense rainfall periods.

- Model results demonstrate that flap gates installed at 80A and 80E would prevent reverse flow from the EBSS into the Fayette and Burnet Trunk Sewers. During the 90% and 80% design storms the flap gates allow more wet-weather flow to be stored in the EBSS.

- Model results show that flap gates would increase surcharge conditions especially at the upper storage chamber than is currently experienced. However, as previously concluded, automated control gates could minimize this surcharging.

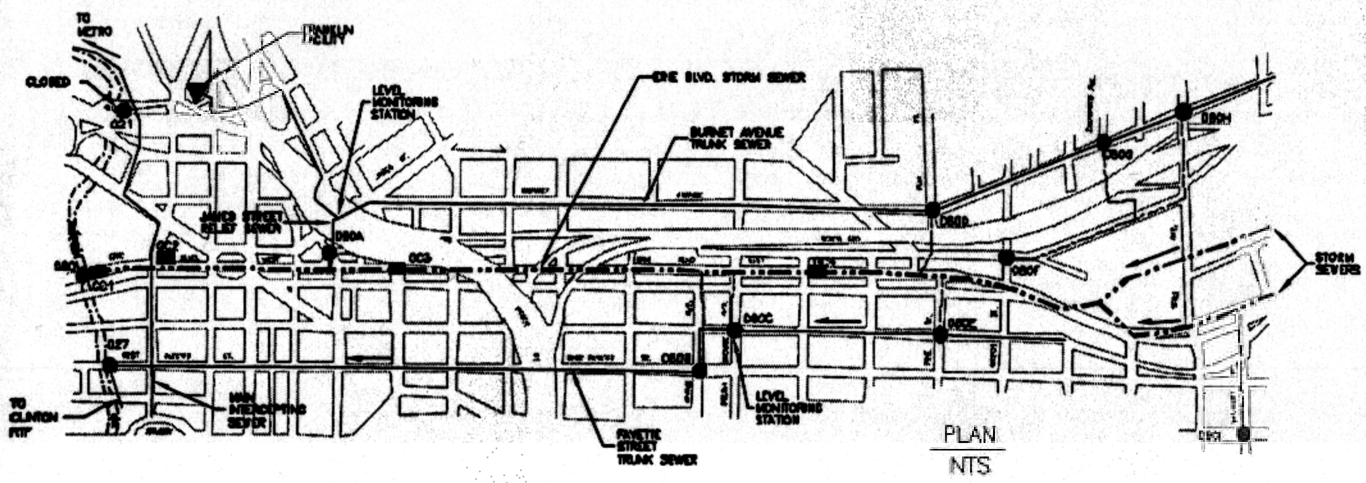
- Modifying the EBSS to store CSO and convey separate stormwater was evaluated and found to be impractical due to the interconnections of existing overflow pipes to the EBSS. The existing conduit cannot be modified to isolate stormwater from CSO.

RECOMMENDATIONS

- The control gates should be made operational and be controlled based on rainfall conditions, water surface elevations, and flow information.

- Consideration should be given to flap gate installation at 80A and 80E.

- Once the EBSS is operational, an evaluation should be developed in combination with system modeling to maximize operational control. Monitoring data can be used to evaluate the performance of the EBSS while use of modeling will help in understanding the benefits of changes in operational strategies.



PLAN
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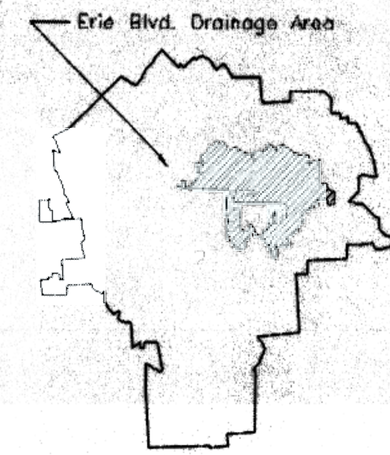
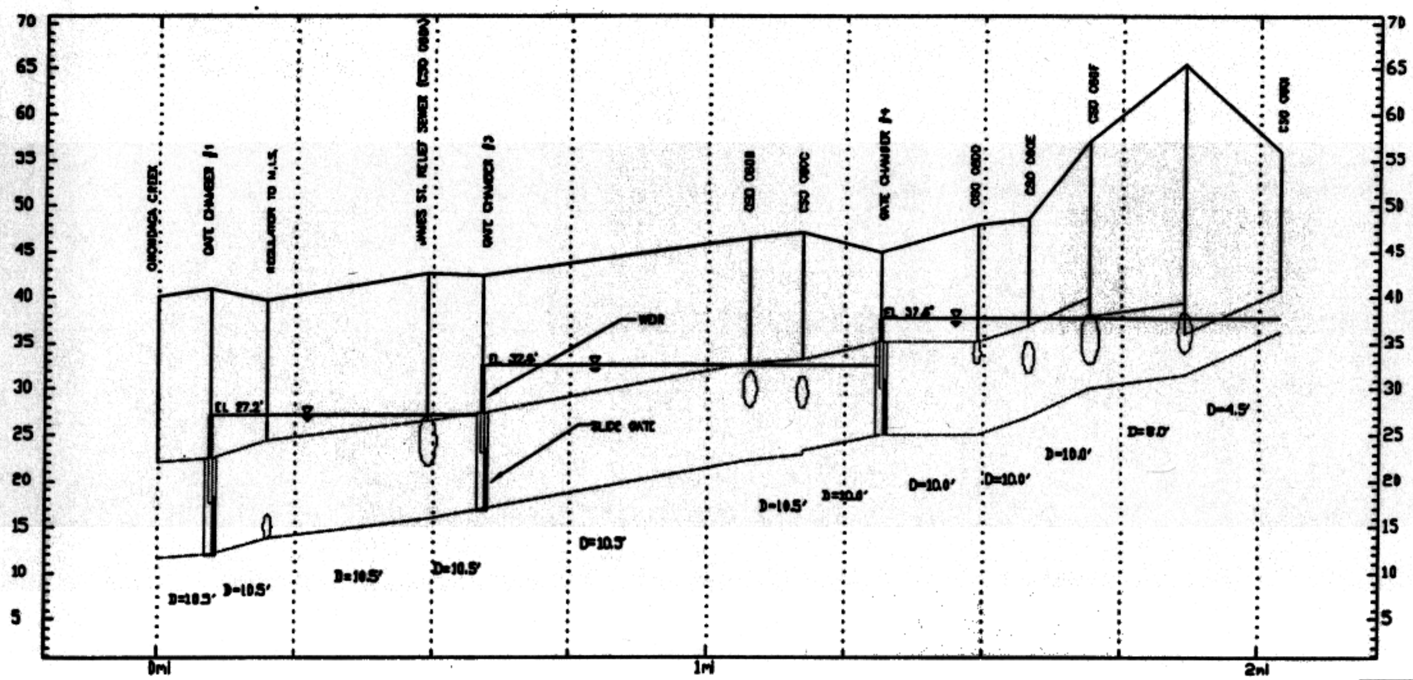


CITY OF SYRACUSE, NEW YORK



PROFILE
Scale Approx. As Shown

DATE: 8/00

FIGURE 1
ERIE BLVD. STORM SEWER SYSTEM
OPERATION (SLUICE GATES CLOSED)

MOFFA & ASSOCIATES
CONSULTING ENGINEERS, LLP

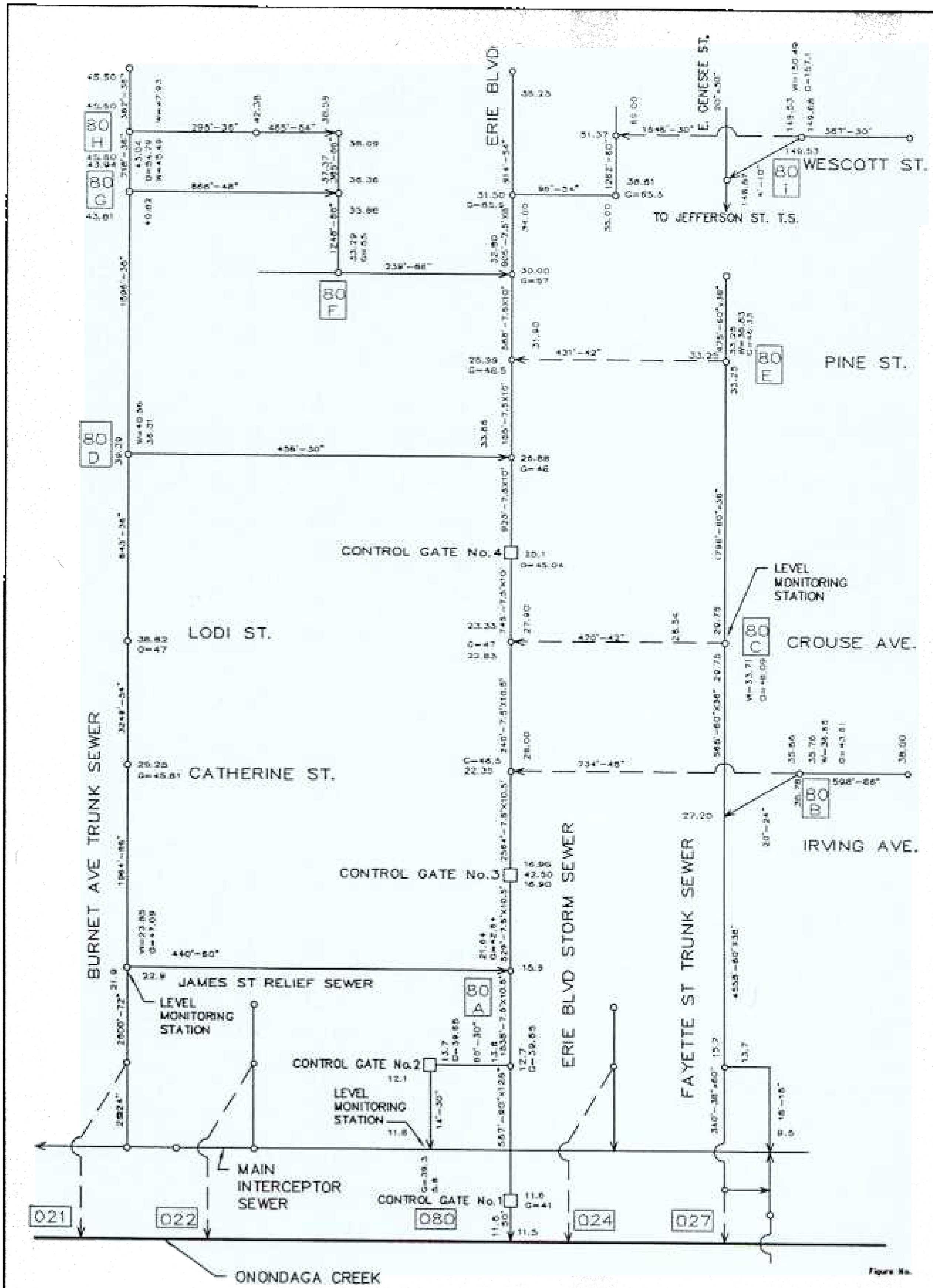


Figure No.

MOFFA & ASSOCIATES CONSULTING ENGINEERS SYRACUSE, NEW YORK	ONONDAGA COUNTY	Date 7/21/2006
	Erie Boulevard	Figure No.
INVERTS, CONDUIT LENGTHS & SIZES — Existing Conditions	Storm Sewer Schematic	2

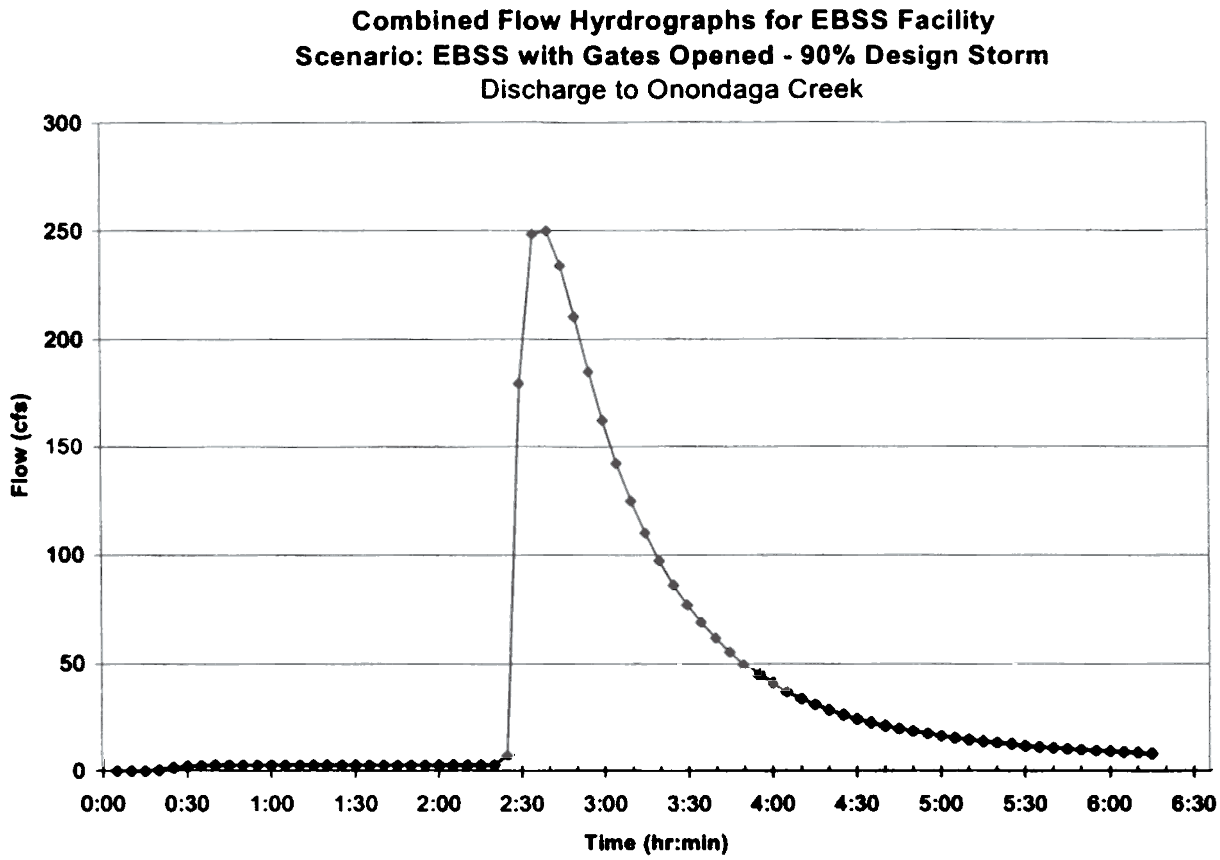


Figure 3. Discharge Hydrograph to Onondaga Creek EBSS Gates Opened 90% Design Storm

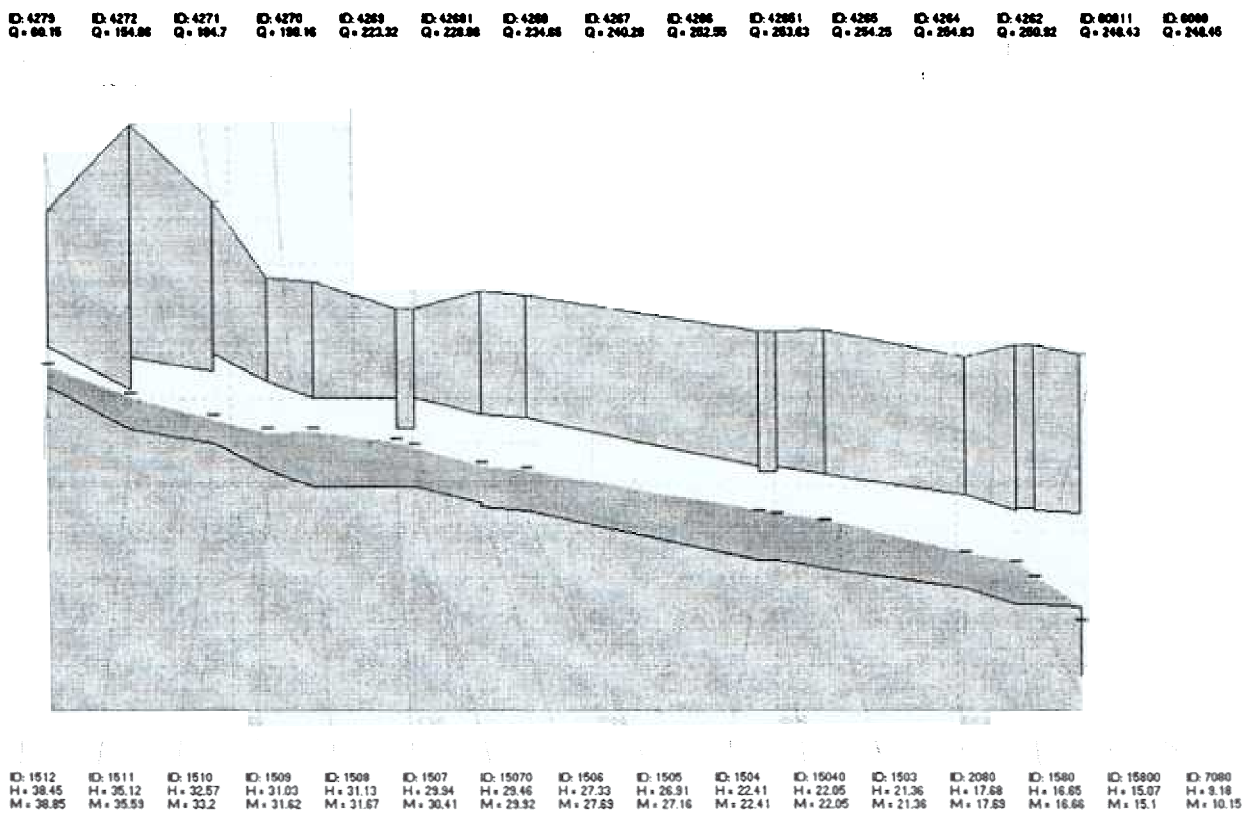


Figure 4. Hydraulic Grade Line EBSS Gates Opened 90% Design Storm

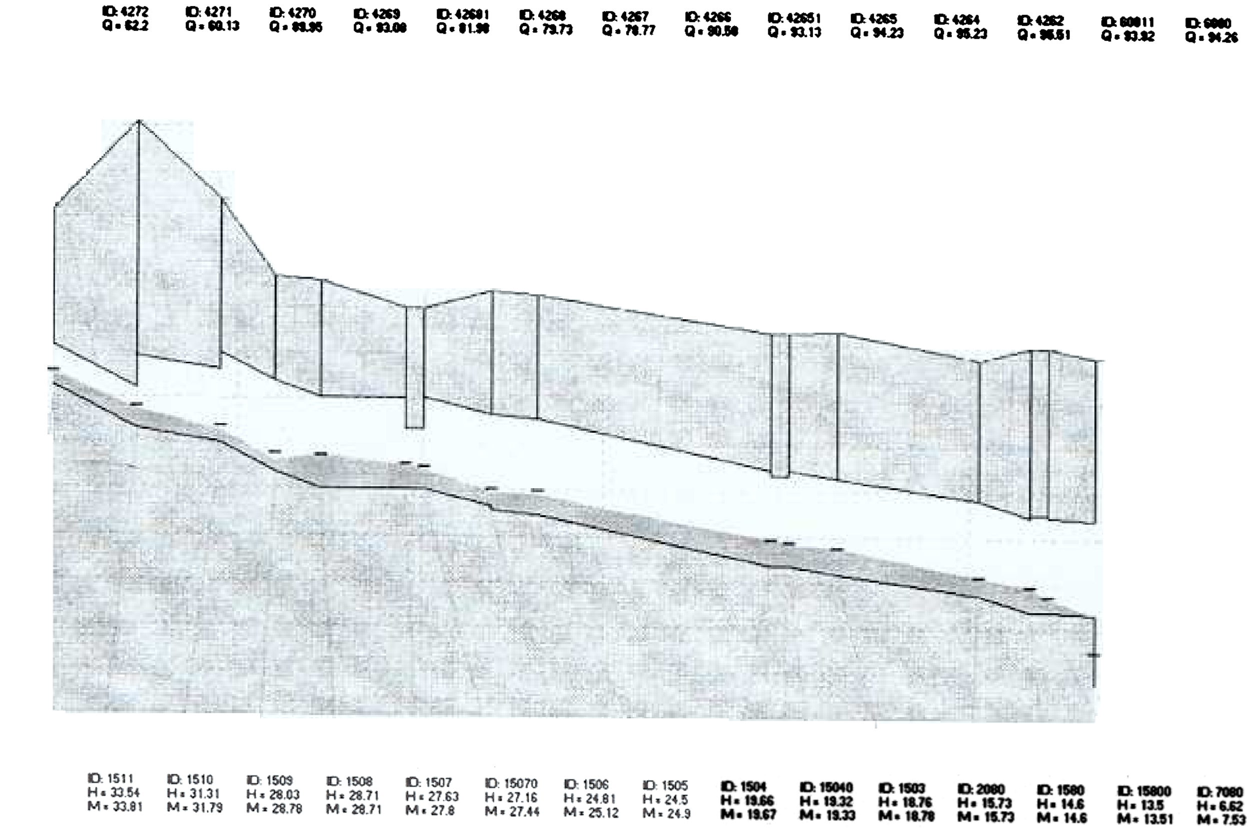


Figure 5. Hydraulic Grade Line EBSS Gates Opened 80% Design Storm

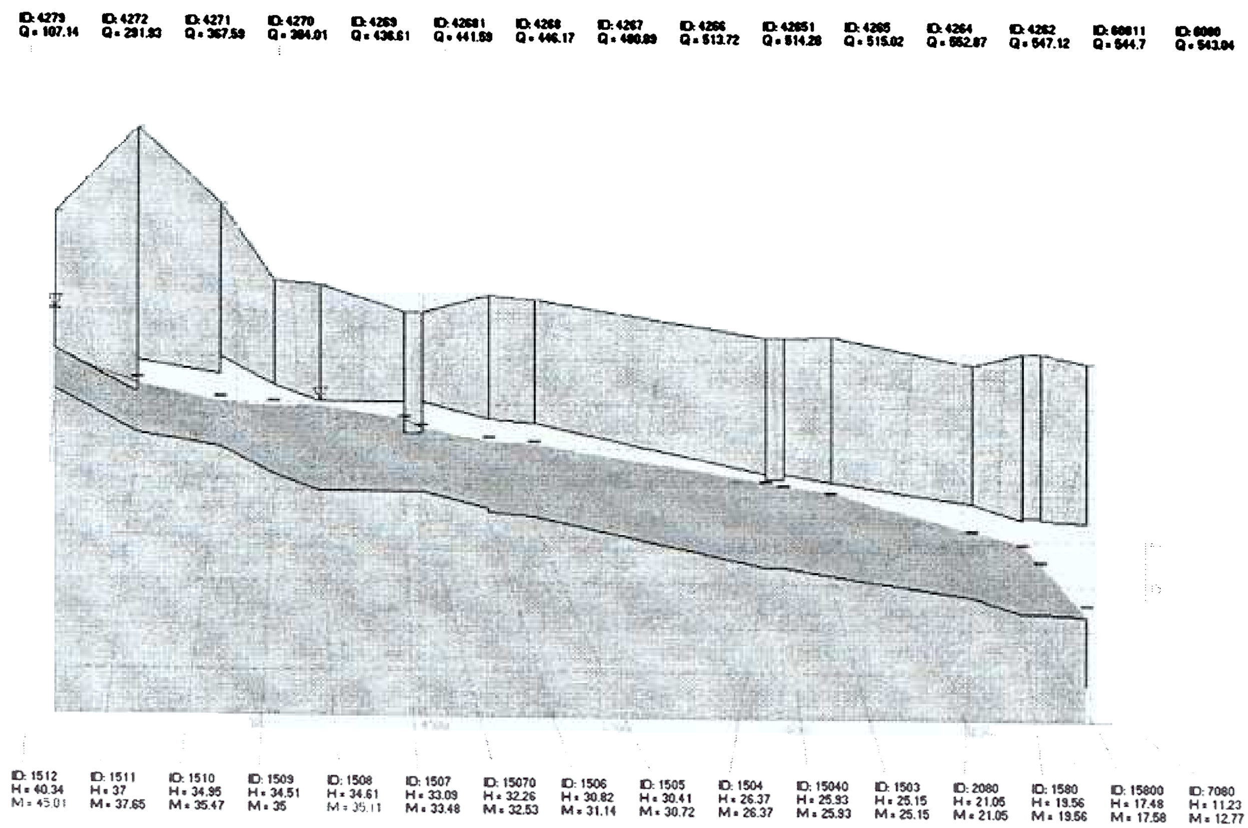


Figure 6. Hydraulic Grade Line EBSS Gates Opened 1-Yr Design Storm

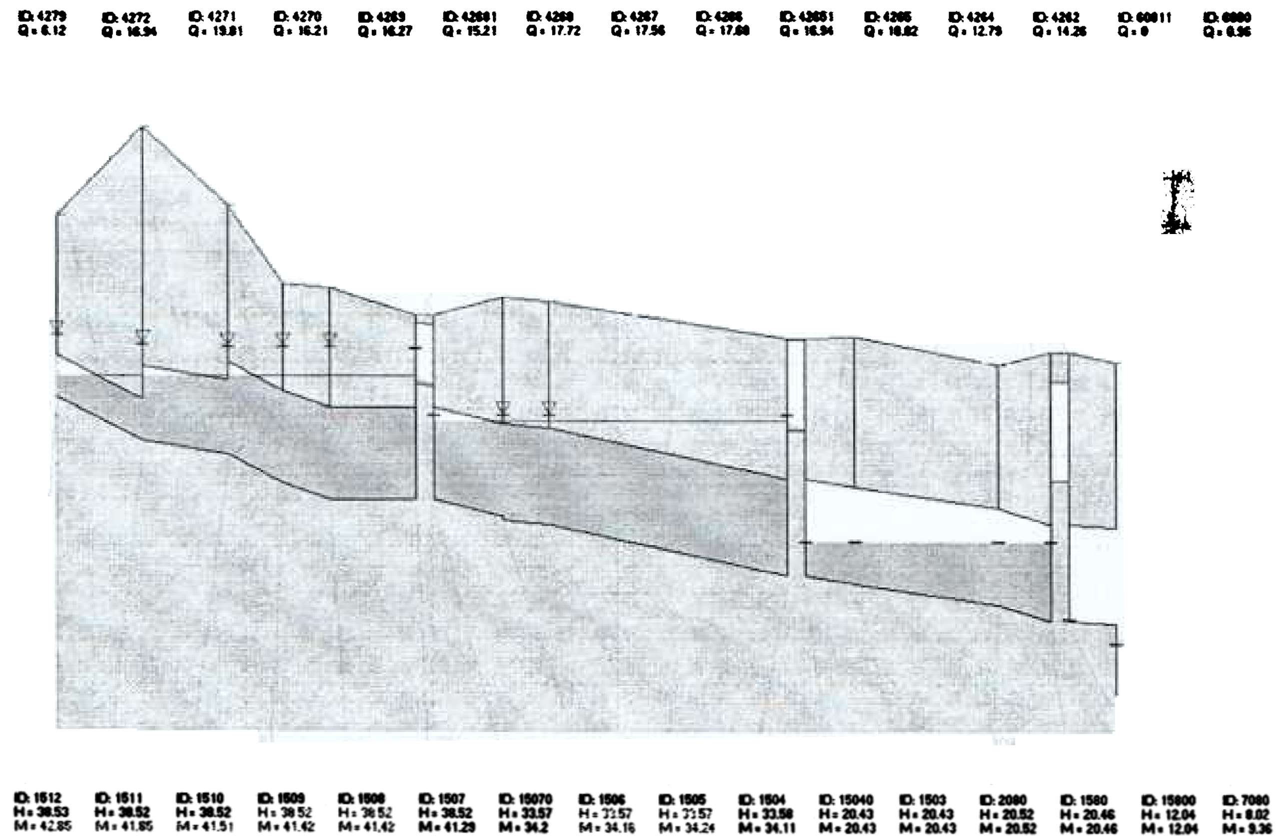


Figure 7. Hydraulic Grade Line EBSS Gates Closed 90% Design Storm (Facility Peak HGL)

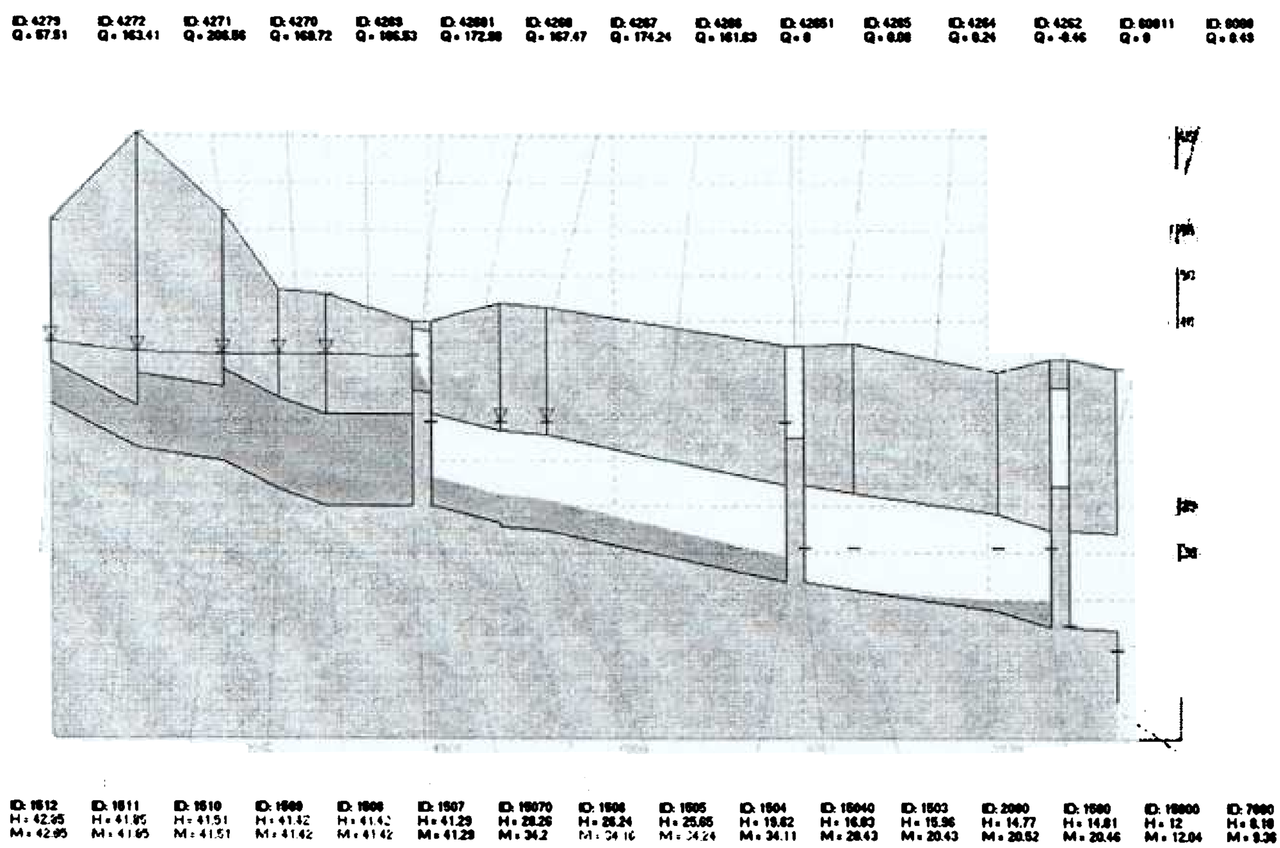


Figure 8. Hydraulic Grade Line EBSS Gates Closed 90% Design Storm (Upper Chamber Peak HGL)

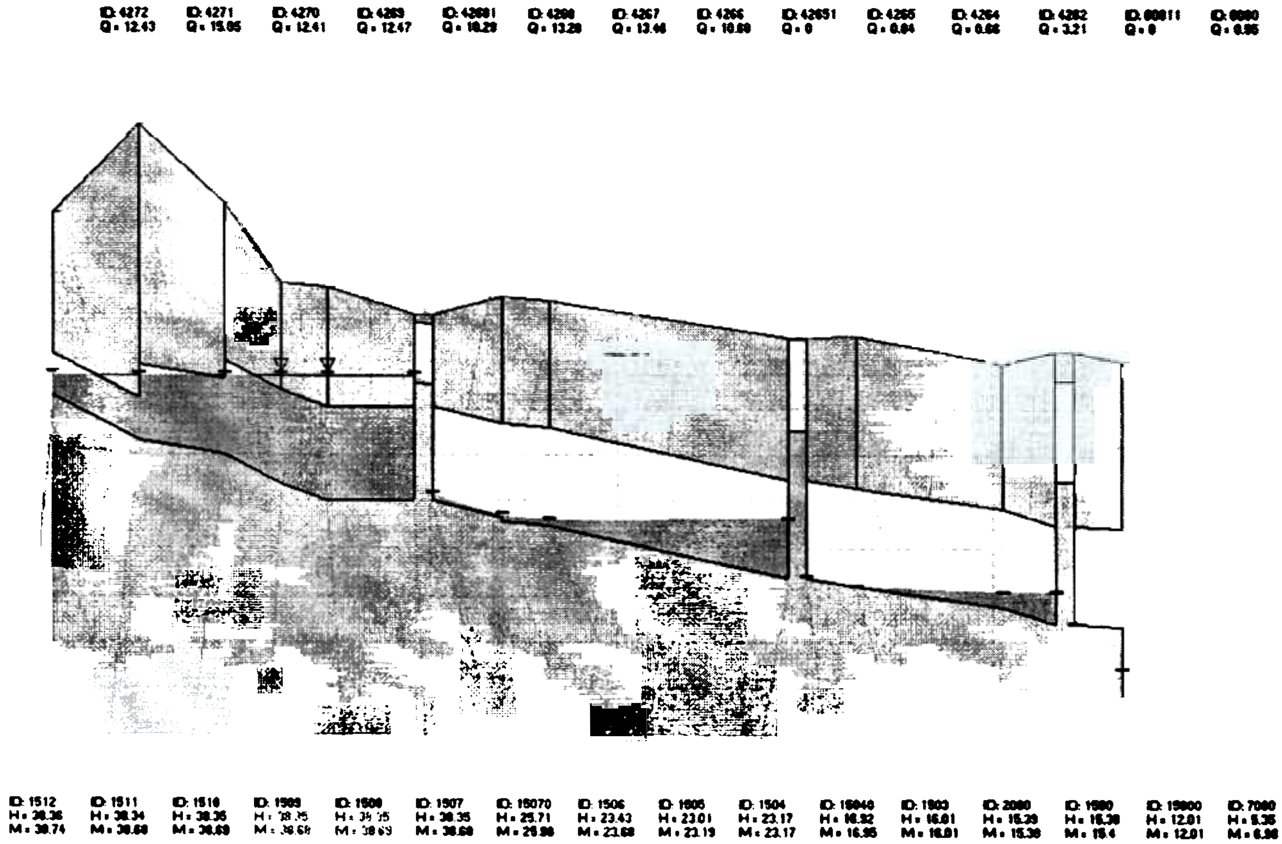


Figure 9. Hydraulic Grade Line EBSS Gates Closed 80% Design Storm

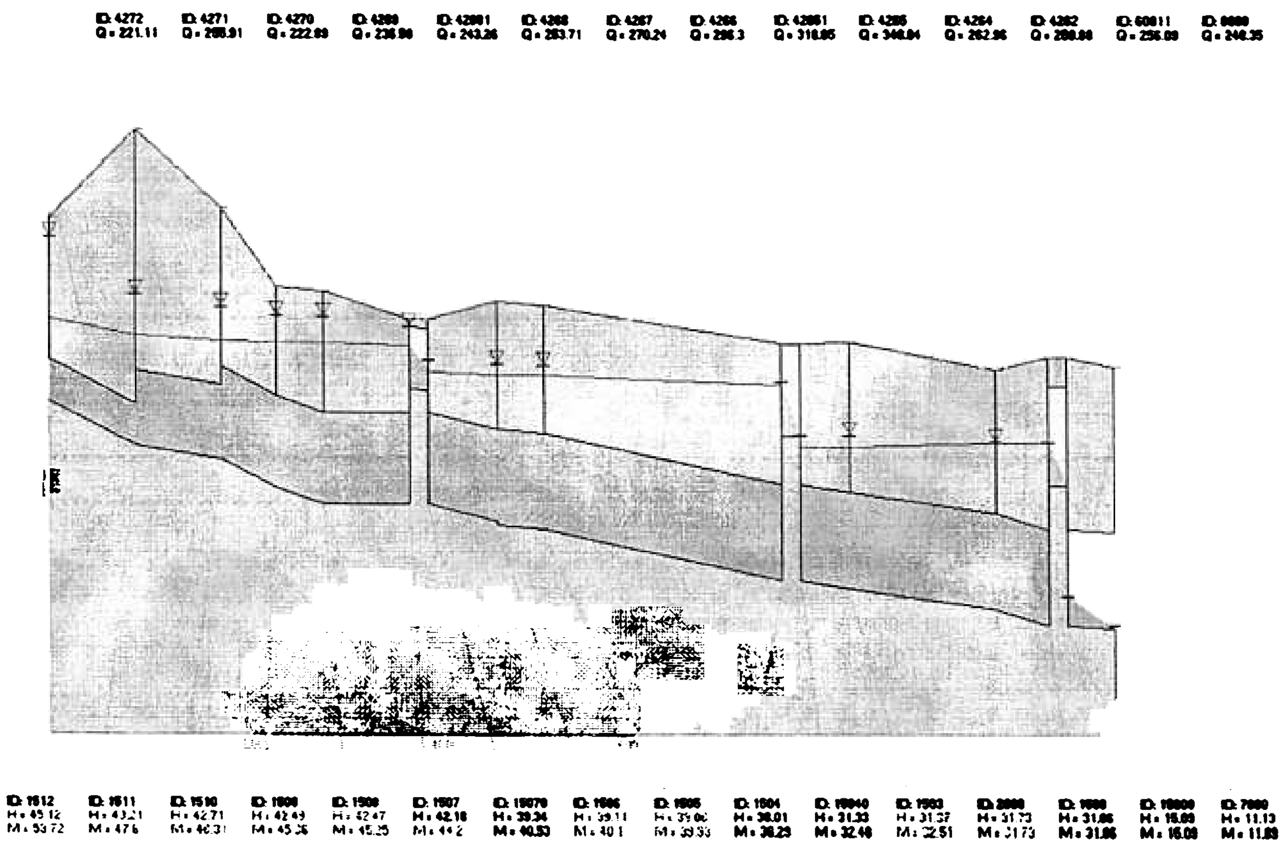


Figure 10. Hydraulic Grade Line EBSS Gates Closed 1-Yr Design Storm

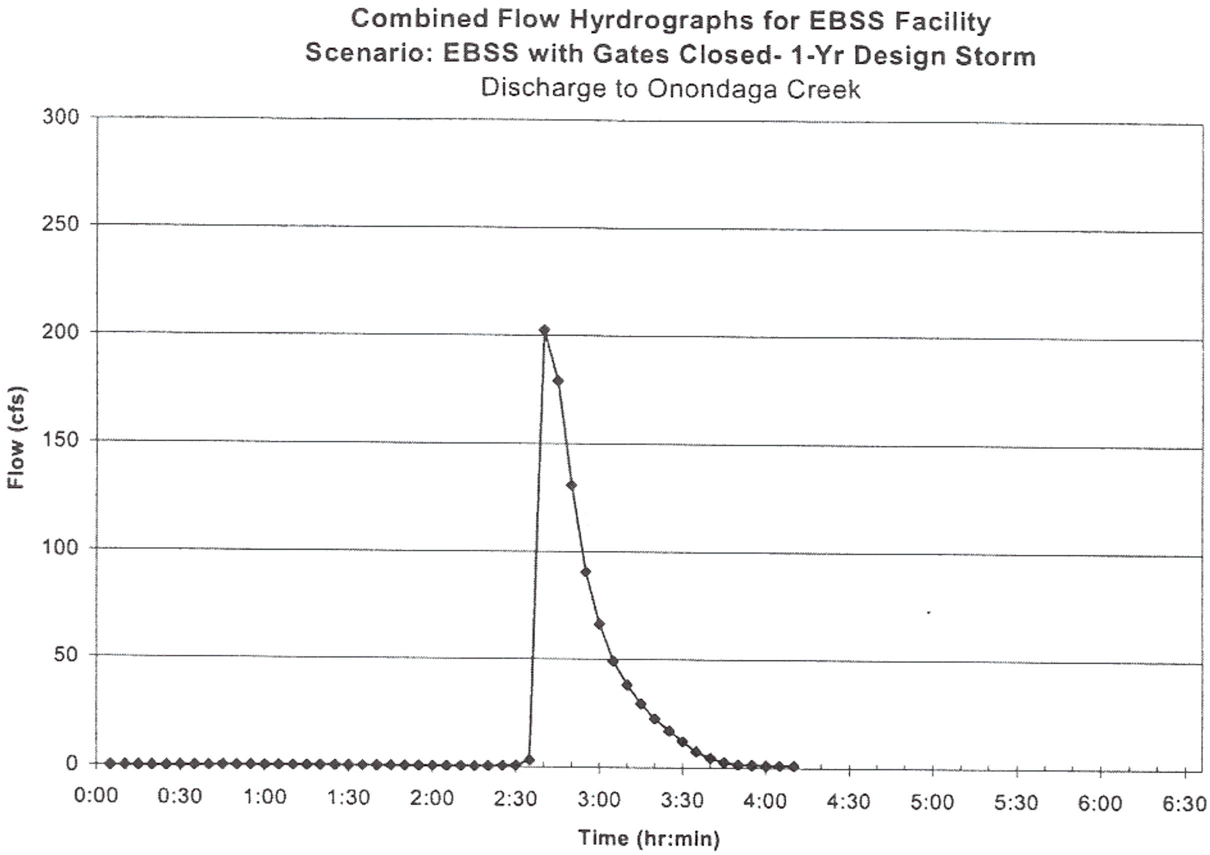


Figure 11. Discharge Hydrograph to Onondaga Creek EBSS Gates Closed 1-Yr Design Storm

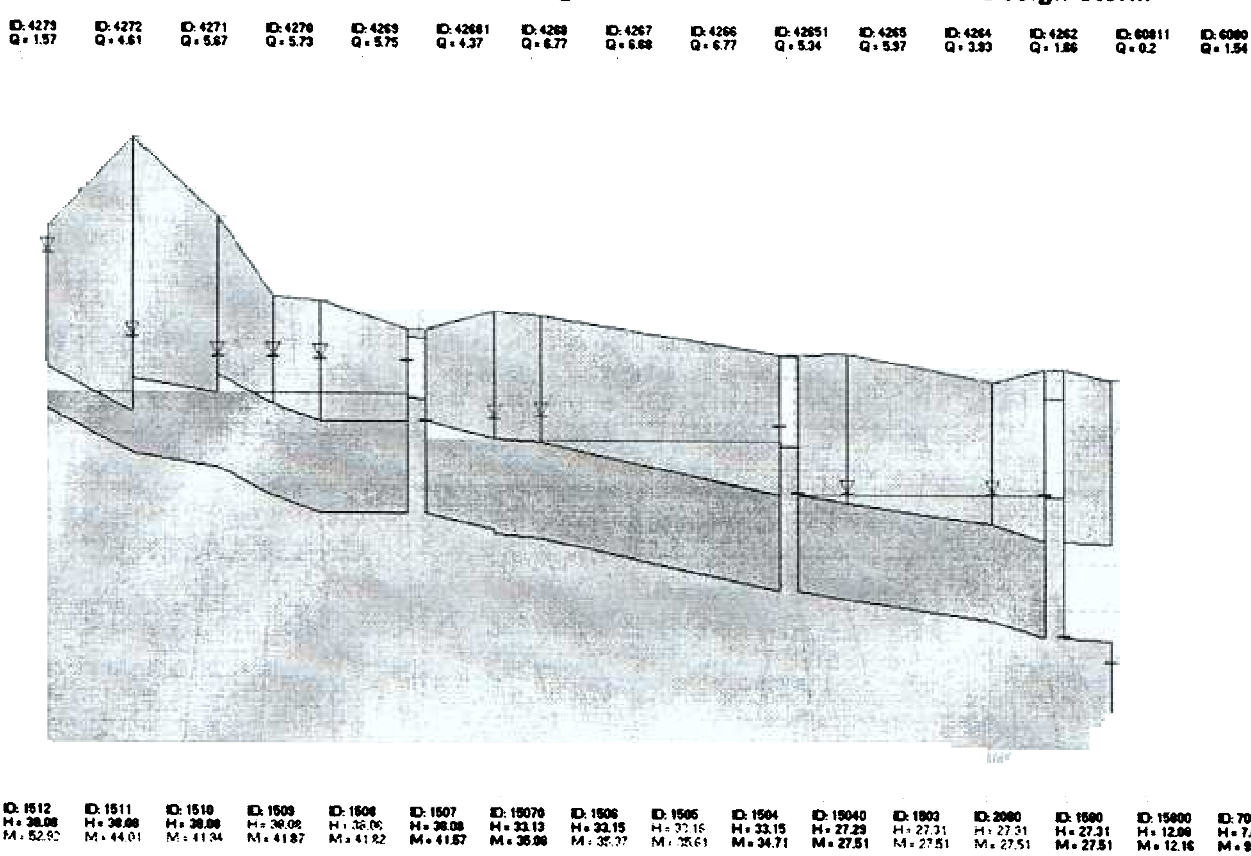


Figure 12. Hydraulic Grade Line EBSS Gates Closed Flap Gates Installed 90% Design Storm (Facility Peak HGL)

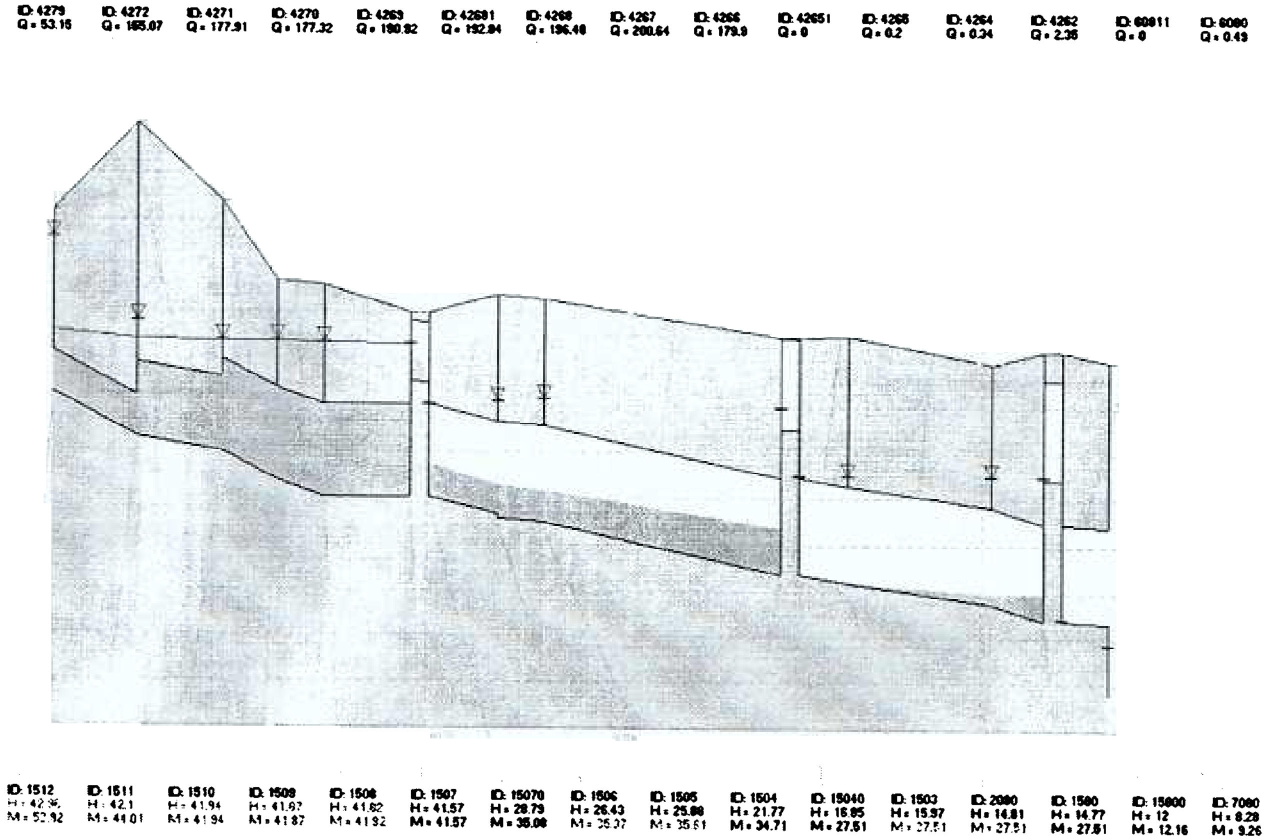


Figure 13. Hydraulic Grade Line EBSS Gates Closed Flap Gates Installed 90% Design Storm (Upper Chamber Peak HGL)

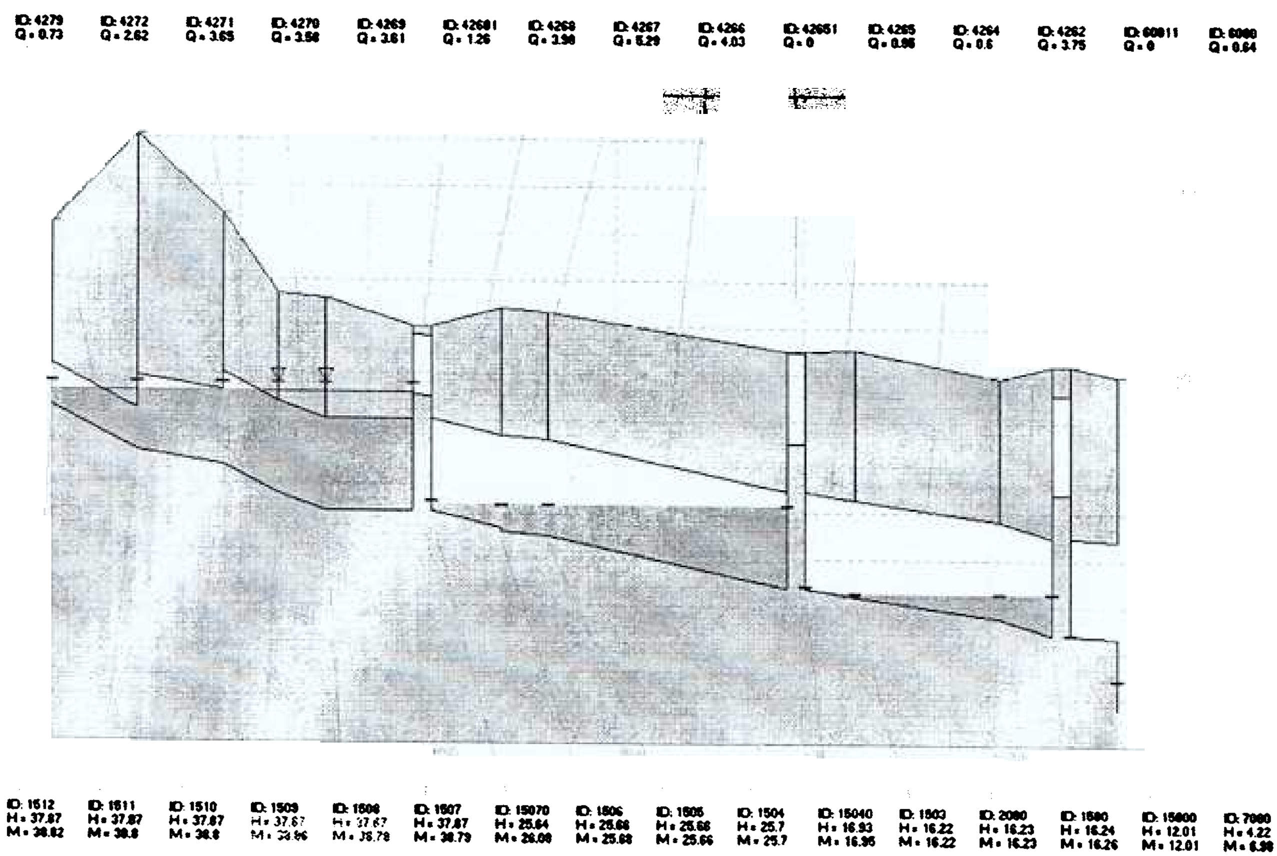


Figure 14. Hydraulic Grade Line EBSS Gates Closed Flap Gates Installed 80% Design Storm

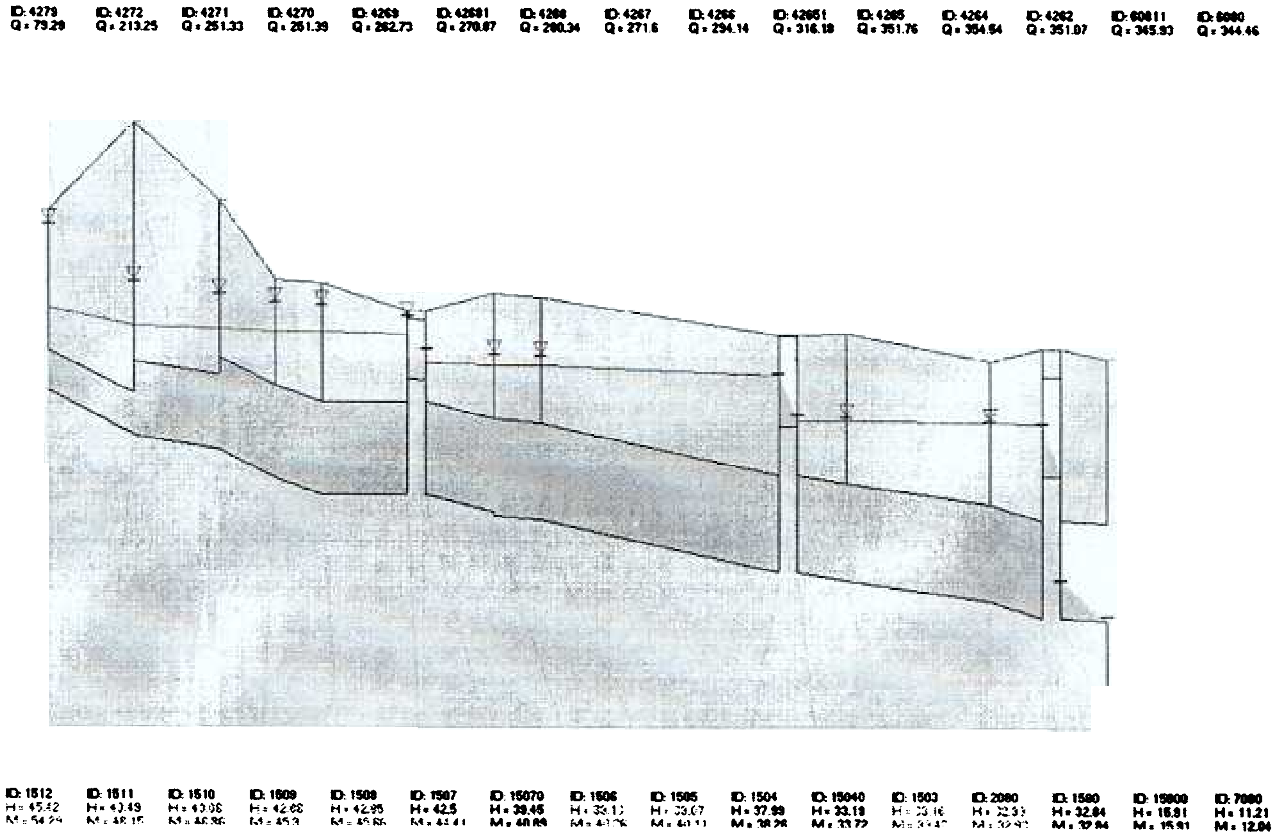


Figure 15. Hydraulic Grade Line EBSS Gates Closed Flap Gates Installed 1-Yr Design Storm

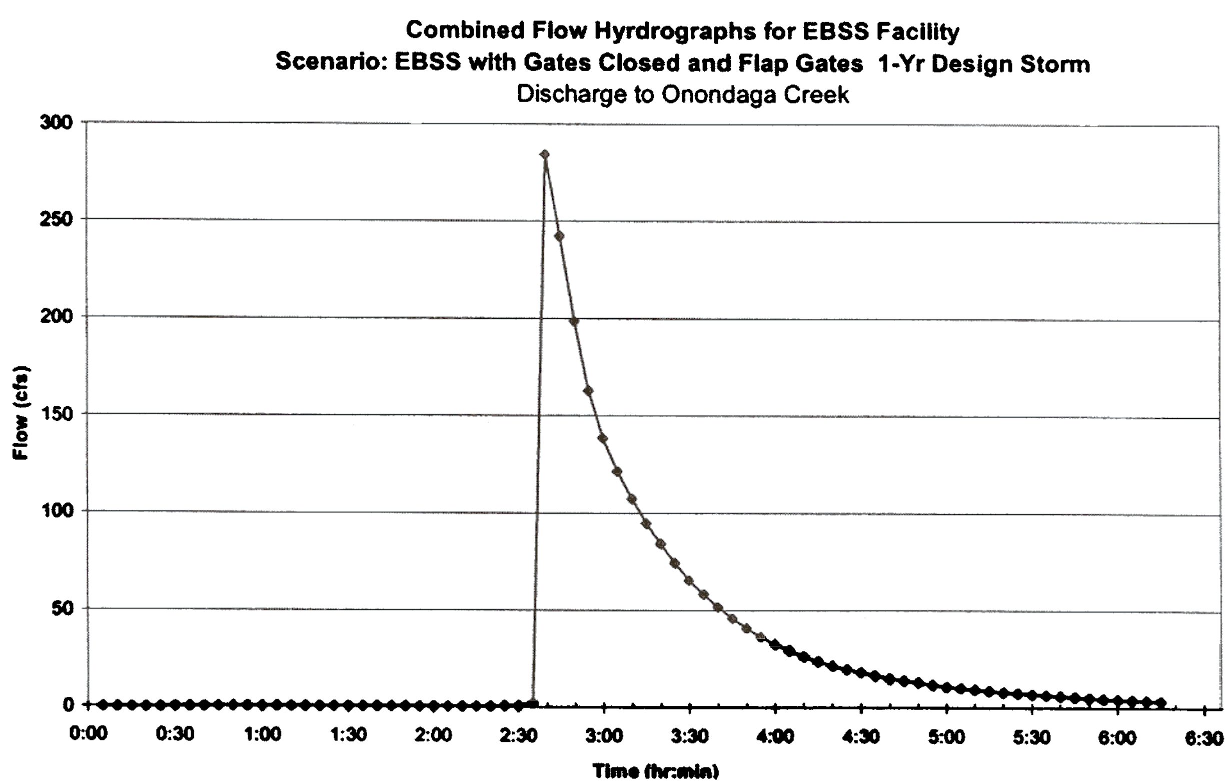
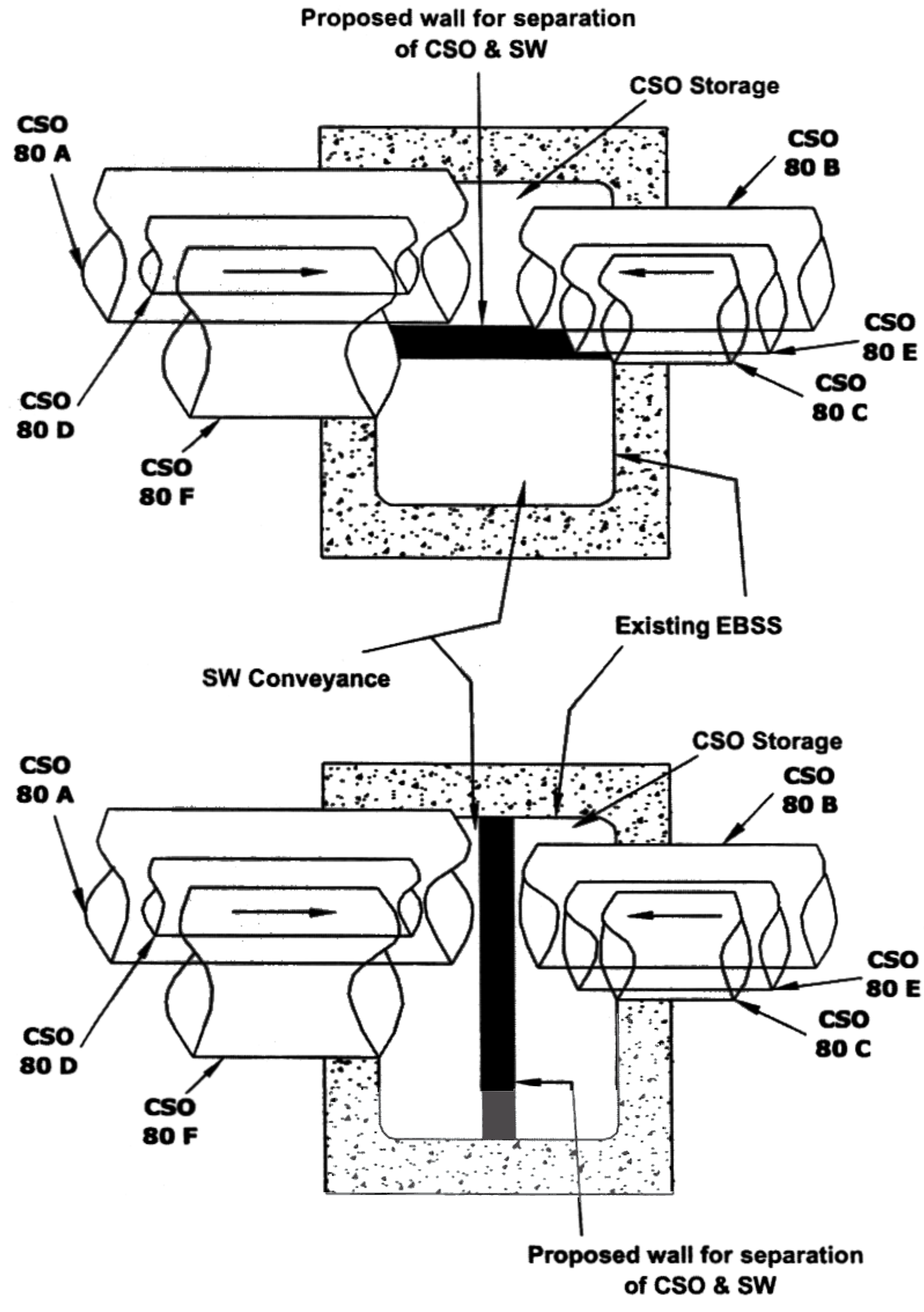


Figure 16. Discharge Hydrograph to Onondaga Creek EBSS Gates Closed Flap Gates Installed1-Yr Design Storm



MOFFA & ASSOCIATES
CONSULTING ENGINEERS
SYRACUSE, NEW YORK

Schematic of
EBSS Storm Water
Alternatives

DATE: 7/20/2000

Figure
17

PIT

ACCOUNTS PAYABLE RECLASS FORM

Company: Parsons-Syracuse (091)

Vendor/Employee No: A4444

Vendor/Employee Name: Wheels, Inc.

P.O. Number	Line Item	Job Number	WBS	Cost Code	Cost Type	From Amount	To Amount	Voucher Number	Line Number
0714-40095	000-003	740-882	04300	9516	~~49~~ 41	799.52		050307608	9
		743-157	12000	9516	~~49~~ 41		399.76		
		740-882	04300	9516	~~49~~ 41		399.76		

Remarks:
May payment should have been broken up into two projects

Kelly Miller 5/27/03
Preparer — Date

Kelly Miller 5/27/03
Manager — Date

Mary Redmond 5/27/03
Finance — Date

P.O. Form

A/P INQUIRY
Voucher Line Item Detail

5/27/03

Voucher number: 050307608 Line.......: 9 Sequence.: 1
Vendor/Subcntr: A4444 WHEELS, INC.
Batch number..: 362

Invoice.......: 506655 Invoice dte: 5/01/03
Description...: VEHICLE LEASE

Currency type.: USD US Dollars
Total amount..: 799.52 Discount...:
Retention.....: Held.......:
Target pay dte: 5/31/03

Allocation cde: 04300-00-00-00-9510 Disc. G/L..:
Liability G/L.: 001 07-001 201-100 Expense G/L: 001 07-001 424-180
Organization..: 001 07-001 Home job...: 930010

Job...........: 740882 GRIFFISS AFB REMEDIATION
WBS - CCOD...: 04 300 9511 Cost type..: 41
Period........: 5 Year: 03
Purchase order: 0714 40095 Change ordr: 0
P.O. line.....: 300